WAPIABI BIOSTRATIGRAPHY

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WAPIABI BIOSTRATIGRAPHY

A THESIS

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The undersigned certify that they have read, and recommend to the faculty of graduate studies for acceptance, a thesis entitled "Wapiabi Biostratigraphy" submitted by Robert Kenneth Germundson in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

Fourteen ammonites, twenty pelecypods, one gastropod, and one crinoid are described and illustrated from four nearly complete sections of the Wapiabi formation in the Alberta foothills between townships 5 and 45. The fauna contains representatives of the five Inoceramus and Scaphites zones of the Wapiabi shale established by Jeletzky (1956). Most of the zonal indices have restricted stratigraphic ranges which can be traced throughout the foothills.

The lithology of the members and sub-members of the Wapiabi formation is discussed, and their local or regional significance is indicated.

The characteristics of the Cardium-Wapiabi contact are described, and a comparison is made between the Transition beds at the top of the Wapiabi and the overlying Brazeau or Belly River beds.

ACKNOWLEDGEMENTS

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The writer also acknowledges the cooperation of the Geology Department, University of Alberta, in extending the use of all available facilities.

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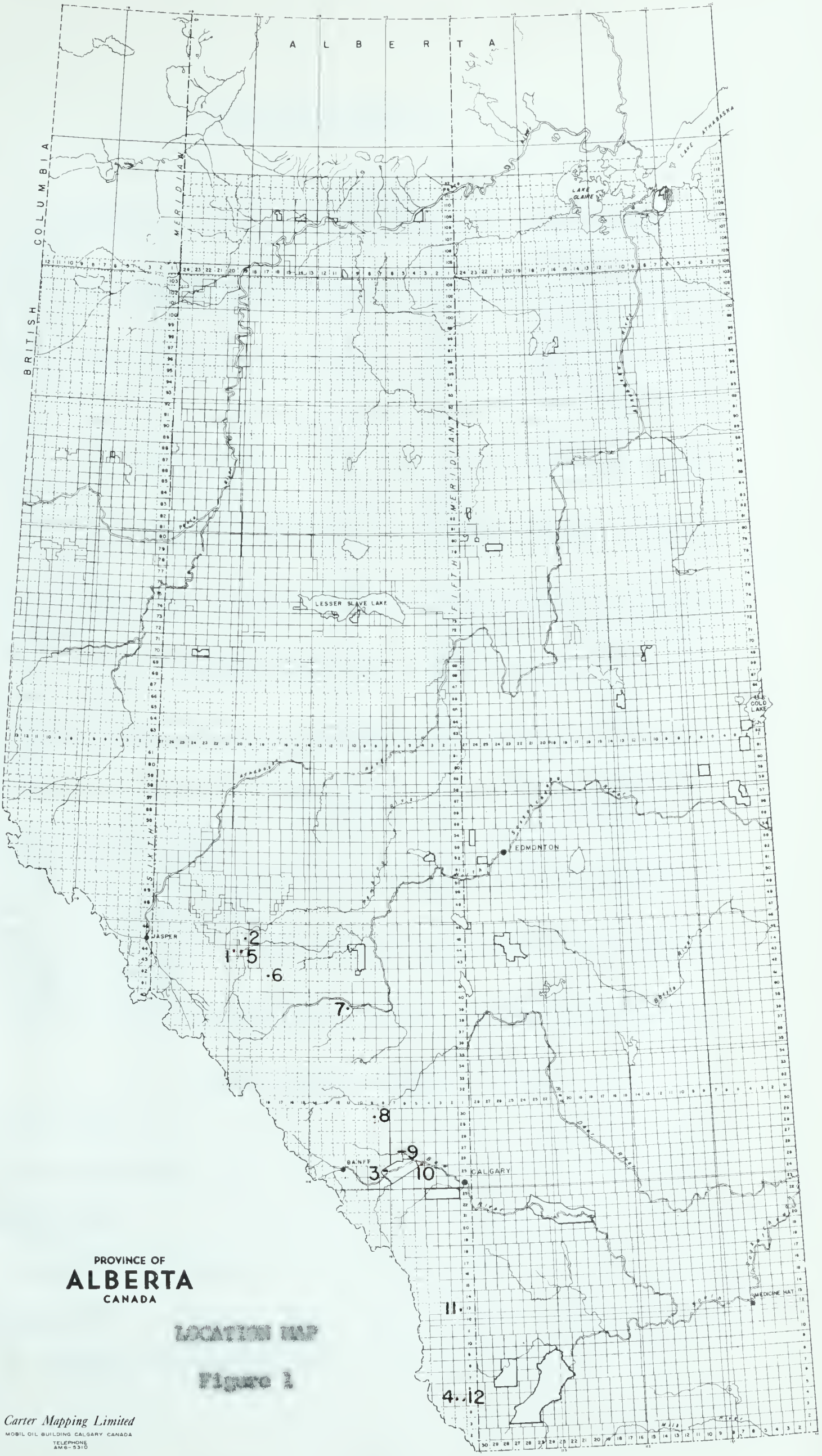


PROVINCE OF
ALBERTA
CANADA

LOCATION MAP

Figure 1

Carter Mapping Limited
MOBIL OIL BUILDING CALGARY CANADA
TELEPHONE
AM6-5310

KEY TO LOCATION MAP

Locality	Index Number	Reference
Thistle Creek; S. 14 and 15, T. 44, R. 21, W. 5	1	Appendix R.C.A. locality JW-59-3
Cardinal River; S. 13, T. 45, R. 20, W.5.	2	Appendix R.C.A. locality JW-59-4
Oldfort Creek; T. 25, R. 8, W. 5.	3	Appendix R.C.A. locality JW-59-2
Mill Creek; S. 12, T. 5, R. 2, W. 5.	4	Appendix R.C.A. locality JW-59-7
Thistle Creek; S. 16 and 17, T. 44, R. 20, W. 5.	5	Stott (1956), section 9
Blackstone River; T. 42, R. 18, W. 5.	6	Stott (1956), section 8
Phillips Ancona; Lsd. 8, S. 27, T. 39, R. 11, W. 5.	7	Peterson and Labrecque (1958)
Burnt Timber Creek; S. 3, T. 30, R. 9, W. 5.	8	Evans (1930)
Ghost River; T. 26 and 27, R. 6 and 7, W. 5.	9	Webb and Hertlein (1934)
Shell Jumping Pound No. 13; Lsd. 8, S. 16, T. 26, R. 5, W. 5.	10	Electric log.
Gulf Triad et al Rocking "P". Lsd. 2, S. 19, T. 13, R. 2, W. 5.	11	Electric log.
Texaco Gladstone Creek; Lsd. 6, S. 15, T. 5, R. 2, W. 5.	12	Electric log.

KEY TO CROSS SECTIONS

Cross section A-A[1]

Locality 1-5-2

Cross section B-B[1]

Locality 2-6-7-8-9

Cross section C-C[1]

Locality 3-9-10-11-12-4

CHAPTER ONE

INTRODUCTION

During the summer of 1959, Dr. J.H. Wall of the Research Council of Alberta and the writer sampled and measured nearly complete sections of the Wapiabi formation on Cardinal River, Thistle Creek, Oldfort Creek and Mill Creek, and investigated several sections along the Forestry Trunk road from Blackstone River to Coleman.

The Wapiabi formation, which can be traced throughout the central and southern foothills of Alberta, is of Coniacian and Santonian ages. The position of the boundary between the two stages is based on faunal correlations to Europe (Jeletzky, 1956), and is not a mappable contact.

Megafauna described in this thesis are from the first four localities of the Wapiabi formation and from the Ram River. Representatives of all the fossil zones, defined by Jeletzky (1956), although not found together at any one locality, were obtained from a composite of all five sections.

History of Alberta Group Nomenclature (Table 1).

In 1878, White applied the term, Colorado group, for the Benton and Niobrara formations in Colorado, and stated that there was a faunal break at the top of the Niobrara. In 1889, Eldridge proposed the term, Montana group, for the Pierre shale overlying the Niobrara formation in Montana and adjacent areas. In 1906, Darton divided the Montana group of Colorado into the Telegraph Creek, Eagle, Claggett, Judith River and Bearpaw formations. Greis (1954) has reviewed the history of Upper

Cretaceous nomenclature in the United States, and the above pertinent notes are from his review.

In southern Alberta, Dawson (1884) introduced the name, "Lower dark shales," for a sequence of dark, arenaceous shales occurring below the Belly River group along the Milk and Belly Rivers, and correlated them with marine sediments lying between the volcanics and the Belly River group in the Crowsnest Pass. Later, he (1886) called these marine sediments Benton and (Niobrara?).

The term, "Cardium Sand", was introduced by Cairnes (1907) for the ridge-forming sandstone occurring in this same marine shale sequence.

Malloch (1908), in his first report on the Bighorn Coal basin, suggested the terms Benton (shale), Bighorn (sandstone) and Claggett (shale) formations for this succession lying between the Blairmore formation and Belly River group. In his final report on the Bighorn Coal basin, Malloch (1911) changed his nomenclature and presented the terms Blackstone (shale), Bighorn (sandstone), and Wapiabi (shale) formations, establishing the names for the two shales which are accepted today. Malloch named the Wapiabi formation from Wapiabi Creek for the marine shales occurring between the Bighorn sandstone and the Belly River. He indicated that fossil evidence placed the Wapiabi high in the Colorado group and possibly near the base of the Montana group. The Blackstone formation was assigned lower Benton age.

Leach (1912) called the marine sequence overlying the volcanics in the Blairmore area the Benton-Niobrara. MacKenzie (1914) referred to these same marine beds on the Oldman River as the Benton, and indicated that the shales above the quartzose sandstone (Cardium) were more arenaceous than those below.

During the period from 1914 to 1917 workers used various modifications of previous systems of nomenclature for these marine shales and sandstones. Dowling (1914) applied the names Niobrara-Benton, Cardium and Claggett formations to the sequence on the Sheep River, and stated that no Niobrara type of calcareous shale was found. MacVicar (1917) correlated the Dakota formation with the Blairmore formation, and indicated that the latter was overlain conformably by the Benton shales.

Hume (1927) suggested that the terms Colorado and Benton were not applicable to the marine beds, because a Baculites of Montanan age was found near the top of the section. He referred to Cairnes' (1914) work in the Moose Mountain area where this upper unit was assumed to be the equivalent of the Claggett shale, and indicated there was no support for this correlation even though Montana age was recognized. Hume (1928) used Lower Benton, Cardium and Upper Benton members, but implied again that the term Upper Benton was inappropriate because of the presence of Montanan fossils.

Further work led Hume (1930) to propose the term Alberta shale group for "the series of marine shales mostly Colorado and Montana in age occurring in Turner Valley and adjacent areas between the Blairmore and Belly River formations". In his argument for suggesting this term, he indicated that "the lower part of the so-called Benton formation may be of Dakota age, the greater part of the so-called Benton is, however, Colorado age, although at the very top of the formation there are a few hundred feet of marine shales of Montana age". Thus, the existence of both Coloradoan and Montanan fossils in these formations induced Hume to discard the names "Benton" and "Colorado" in favour of the new term, "Alberta group".

Webb and Hertlein (1934) further subdivided the Blackstone and Wapiabi formations into members, which generally, are recognizable over a large area of the central foothills region. Their "zonal" study included both lithology and fauna, and the divisions (Lower Concretionary, Platy, Upper Concretionary and Transition members) are accepted today. Later workers, including Stott (1956), further subdivided the members in local areas of the Alberta foothills, and these are shown in table 1.

COMPOSITE CORRELATION CHART OF UPPER CRETACEOUS ROCKS OF THE NORTH AMERICAN WESTERN INTERIOR

STAGES	MONTANA AND NORTH DAKOTA	ALBERTA PLAINS AND FOOTHILLS
DANIAN	HELL CREEK FORMATION	EDMONTON FORMATION ss., 1000'
MAESTRICHIAN	FOX HILLS FORMATION ss., 500'	
CAMPANIAN	MONTANA GROUP — PIERRE FORMATION sh., 700': BEARPAW FORMATION sh., / JUDITH RIVER FORMATION ss. / CLAGGETT FORMATION sh., 200' / EAGLE FORMATION ss., 500'	BEARPAW FORMATION sh., 800' / BELLY RIVER FORMATION ss., 2500' / LEA PARK FORMATION sh., 700'
SANTONIAN	TELEGRAPH CREEK FORMATION ss. 300'	TRANSITION MEMBER ss. & sh., 130'
CONIACIAN	COLORADO GROUP — NIOBRARA FORMATION ls., 500'	ALBERTA GROUP — WAPIABI FORMATION 1700': UPPER CONCRETIONARY MEMBER 360' (UPPER CONCRETIONARY SILTSTONE SUB-MEMBER 180' / UPPER CONCRETIONARY SHALE SUB-MEMBER 180') / PLATY SHALE MEMBER 550' / LOWER CONCRETIONARY MEMBER 660' (LOWER CONCRETIONARY SHALE SUB-MEMBER 350' / LOWER CONCRETIONARY SILTSTONE SUB-MEMBER 160' / STRIPED SUB-MEMBER 150') / CARDIUM FORMATION ss., 250'
TURONIAN	BENTON FORMATION sh., 800'	BLACKSTONE FORMATION sh., 1000'
CENOMANIAN		LA BICHE FORMATION sh., 350'
UPPER ALBIAN	DAKOTA FORMATION ss., 400'	
L. CRET.		

UPPER CRETACEOUS

TABLE 1

CHAPTER TWO

STRATIGRAPHY

INTRODUCTION

The Wapiabi formation in the central and southern foothills of Alberta is defined as that sequence of silty and arenaceous, marine shales underlain by the Cardium formation and overlain by the Belly River or Brazeau formations.

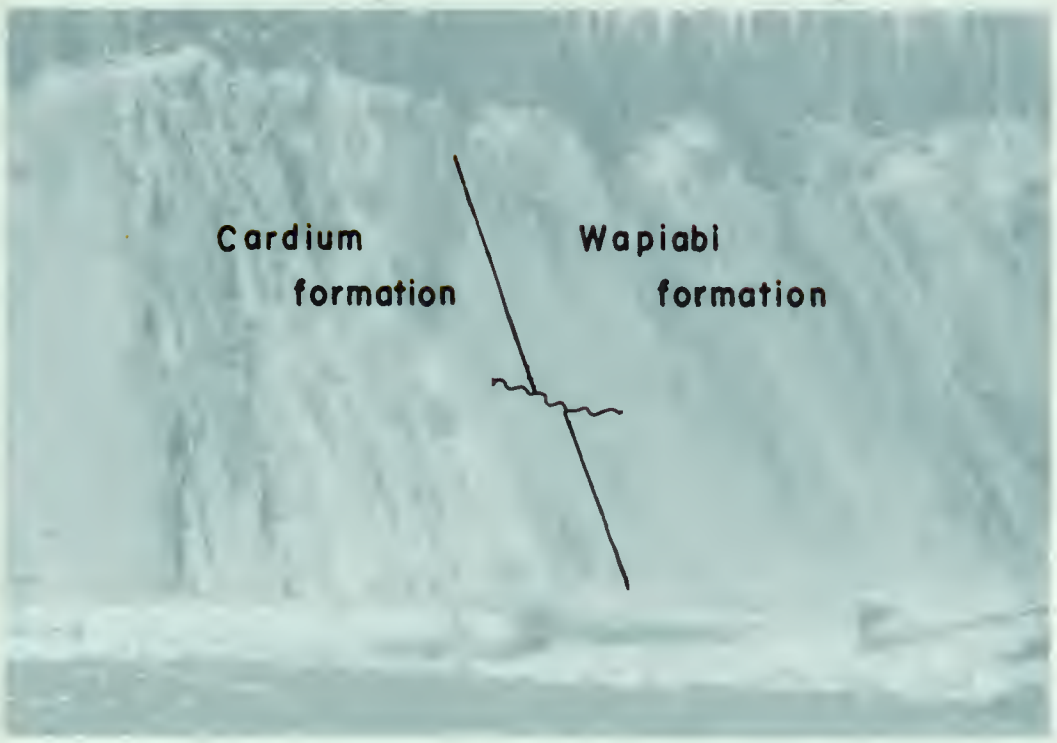
Cardium-Wapiabi Contact

The contact between the Wapiabi and Cardium formations (plate 1) is well-defined, and nearly always associated with a bed of pebbles present in either the upper few feet of the Cardium or the basal few feet of the Wapiabi.

As a general rule, the upper beds of the Cardium contain bands of large, sandy, ironstone concretions which disappear abruptly at the contact. The lowest concretions noted in the Wapiabi formation are usually from 30 to 75 feet above the base, and these are small.

In the central foothills of Alberta, a striking feature, reflecting the sharp contact, is the distinct difference of lithology between the two formations. Upper Cardium beds are usually massive or blocky sandstone or shaly sandstone, whereas basal Wapiabi is dark gray, silty shale containing rare silt laminae. In the southern foothills, on Mill Creek (locality 4), the contact is gradational from sandstone to shale.

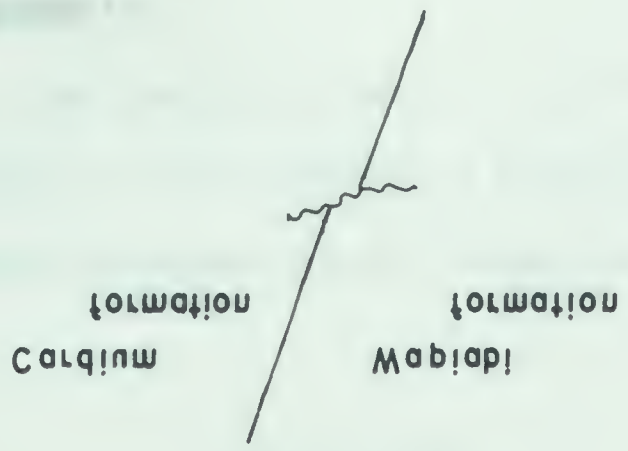
PLATE I



(a) Cardium-Wapiabi contact on Cardinal River (locality 2).

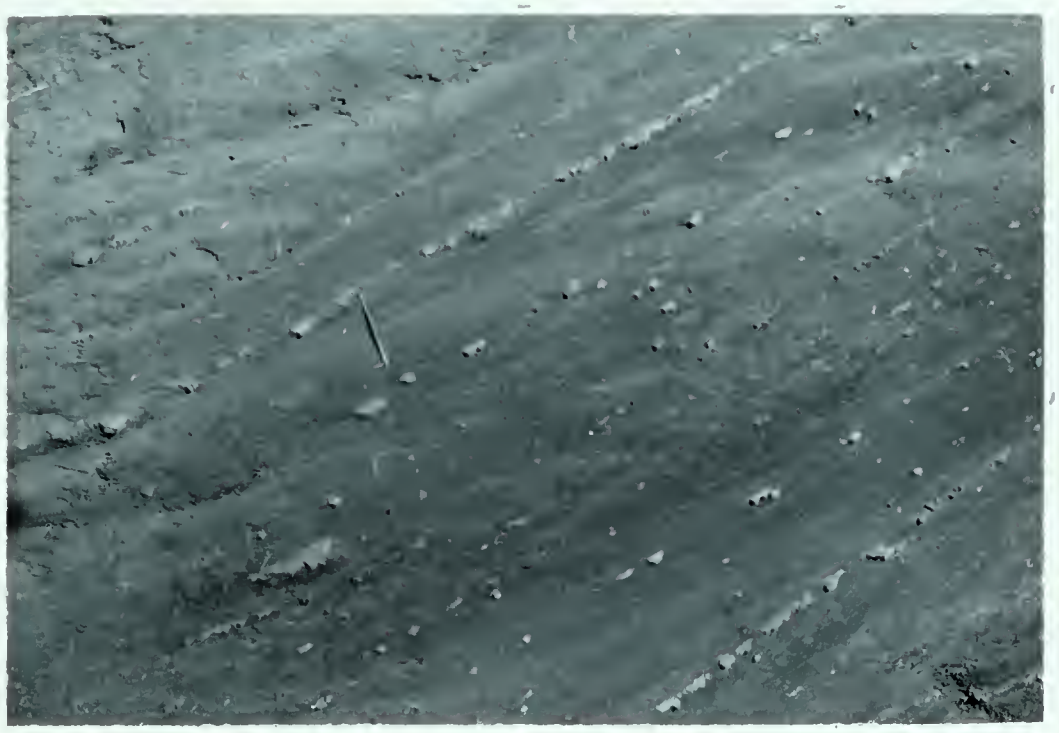
(b) Bands of concretions in the Lower Concretionary Shale sub-member on Cardinal River (locality 2).

PLATE I



(a) Cardiac-inducing contact on cardinal stage (locality 5).

(b) Range of concrescence in the lower cardiac-uninducing contact on cardinal stage (locality 5).



Lower Concretionary Member

In the north-central foothills, on Thistle Creek (locality 1), Cardinal River (locality 2), and Blackstone River (locality 6), three sub-members are recognized in the Lower Concretionary member, which, in ascending order, are the Striped, Lower Concretionary Siltstone and Lower Concretionary Shale sub-members.

The Striped sub-member, which consists of dark grey shale interbedded with siltstone bands, is from 130 to 200 feet thick. The first concretions of the Wapiabi formation are present from 30 to 75 feet above its base, and siltstone bands and laminae become more numerous towards the top.

The Lower Concretionary Siltstone sub-member is mainly hard, homogeneous, blocky, sandy shale containing sporadic concretions, and averages 170 feet in thickness. In the Wapiabi section furthest upstream on Thistle Creek (section 1), however, this sub-member is recognizable as a sequence of shale beds containing a greater concentration of siltstone bands than the under- and overlying sub-members.

The Lower Concretionary Shale sub-member (plate 1), is composed of dark, silty shale interbedded with siltstone bands. Concretions occur either sporadically or in bands throughout the sub-member, which is from 250 to 500 feet thick.

In southern Alberta, the above three sub-members are recognizable on Mill Creek (locality 4), but on Oldfort Creek (locality 3) a subdivision of the Lower Concretionary member is not possible.

The upper 100 to 200 feet of the Lower Concretionary member contain a great many platy siltstone bands similar to those in the overlying Platy Shale member. Usually concretions are rare and disappear

in the section where siltstone bands are most numerous. The contact between the Lower Concretionary and Platy Shale members may be placed arbitrarily where concretions are nearly absent and siltstone bands very platy. On Oldfort Creek, however, abundant concretions in the lower part of the Platy Shale member renders the placement of this contact difficult, and the contact is drawn where platy siltstone bands become the dominant lithology.

Platy Shale Member

The lithology of this member is persistent all along the central and southern foothills (plate 2). The rock embraces 500 to 850 feet of section, and consists of platy siltstone bands interbedded with dark shales. The middle third of the member contains limestone bands and lenses up to 2 feet thick. The member becomes thicker in the western limits of the foothills belt and accounts for much of the thickening of the Wapiabi formation on Thistle Creek (figure 1) in the north-central foothills.

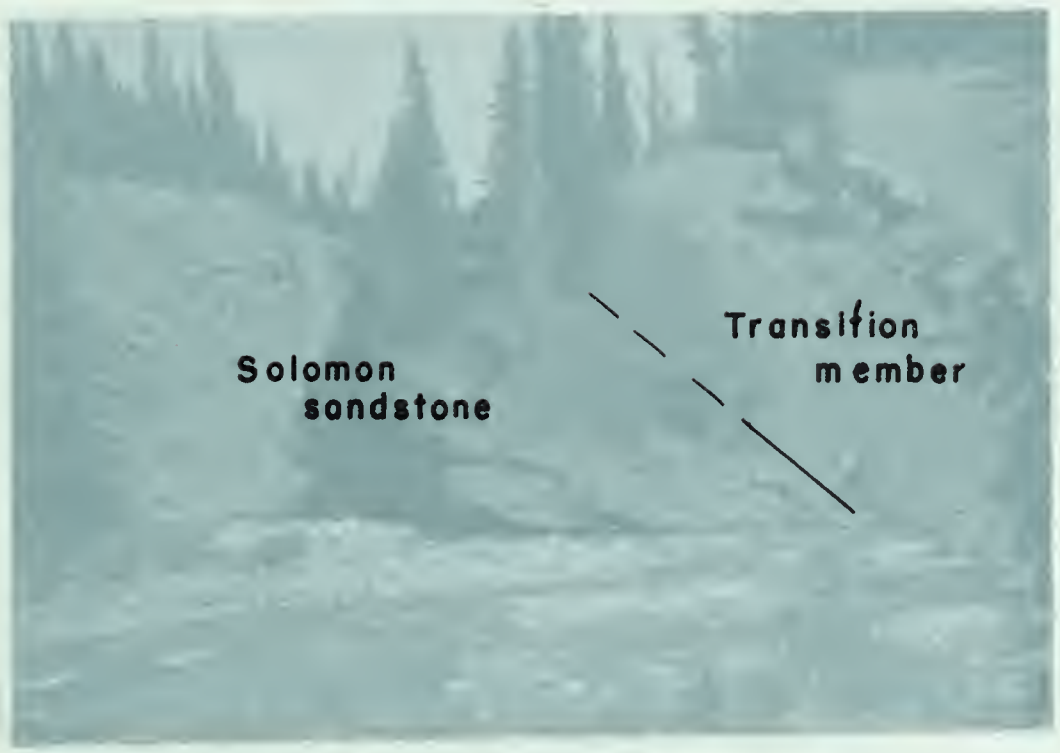
Upper Concretionary Member

This member is only well-defined in the central foothills, and averages 300 feet in thickness. In the north-central foothills, on Thistle Creek (locality 1), Cardinal River (locality 2) and Blackstone River (locality 6), two sub-members are recognizable, which are, in ascending order, the Upper Concretionary Shale and Upper Concretionary Siltstone sub-members.

The Upper Concretionary Shale sub-member consists mainly of

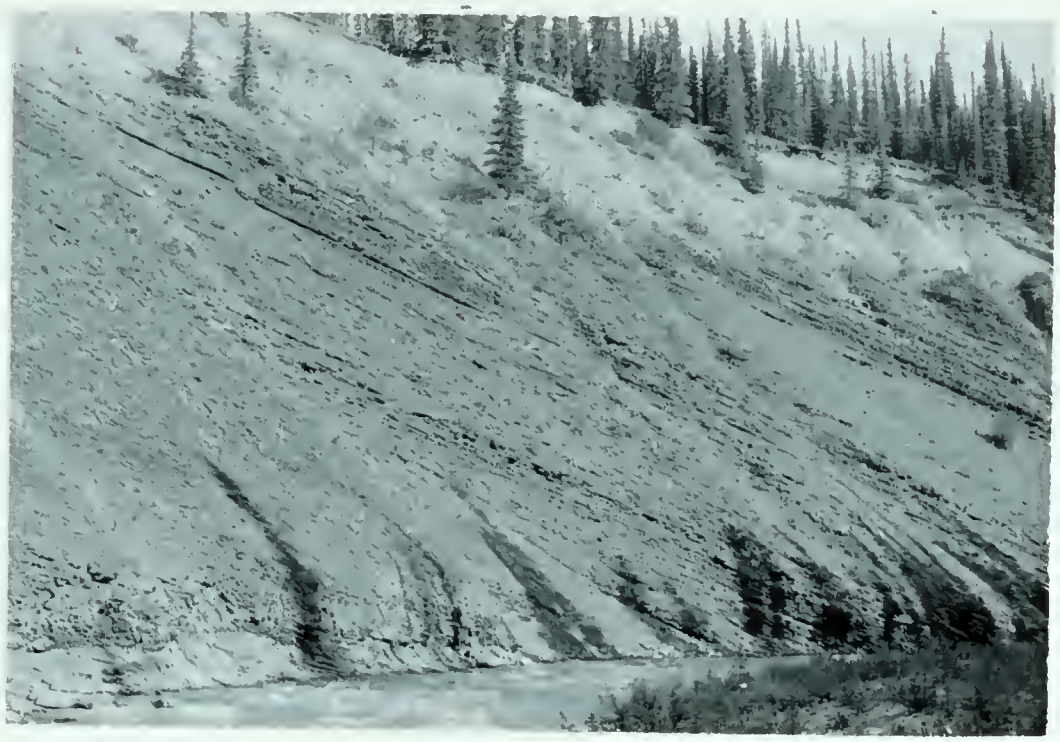
PLATE 2

(a) Exposure of the Platy Shale member on Thistle Creek (locality 1).



(b) Contact between the Solomon sandstone and the Transition member on Thistle Creek (locality 1).

PLATE 5



hard, homogeneous, blocky, sandy shale. The contact with the Platy Shale member is not well-defined in many places as there is a gradual change from platy siltstone to homogeneous, sandy shale, but may be drawn at the lowest occurrence of ironstone concretions.

The Upper Concretionary Siltstone sub-member consists of sandy shale interbedded with siltstone and sandstone bands, and is recognized on Oldfort Creek (locality 3), and in the north-central foothills.

In the north-central foothills, this sub-member, in its typical phase, is developed east of the area studied for this project, where it is regarded as an easterly extension of the Solomon sandstone by Stott (1956). On Thistle Creek (locality 1), the Solomon is a quartzose sandstone but becomes more shaly and silty to the northeast on Cardinal River.

On Mill Creek (locality 4), in southern Alberta, the sequence is not typical of the Upper Concretionary member in the other areas studied. The shale is platy to papery and calcareous, and there are no ironstone concretions; limestone concretions and siltstone bands are very rare.

Transition Member

The Transition member (plate 2), averages 130 feet in thickness, and lies between the Upper Concretionary member and continental deposits of Brazeau or Belly River groups throughout the central and southern foothills. It contains a normal sequence of sediments deposited as the environment changed from marine to continental. Coarser-grained and thicker sandstone beds are present near the top

of the member, and the first continental beds are coarse-grained, massive sandstone which may or may not be conglomeratic.

The Highwood sandstone occurs in the transition member and is from 0 to 100 feet thick. On Oldfort Creek it is not certain whether the Highwood sandstone is present, but a 40 to 50-foot unit of fine-grained sandstone occurs either high up in the Upper Concretionary Siltstone sub-member or within the Transition member itself.

CHAPTER THREE

BIOSTRATIGRAPHY

INTRODUCTION

Wapiabi fossil zones used in this thesis were introduced by Jeletzky (1956) in an unpublished manuscript, and are directly correlative with those of Cobban and Reeside (1952) for the Upper Colorado shale in the United States western interior (table 2).

Jeletzky indicated that Scaphites and Inoceramus are the only animals of any geochronological significance in the Wapiabi succession. Coniacian and Lower Santonian rocks in the North American western interior contain five or possibly six Scaphites zones, which formerly were included in the generalized Scaphites ventricosus zone of McLearn (1926). Species of Scaphites are indigenous; thus, inter-regional and inter-continental correlation is based on more cosmopolitan inocerami.

UPPER TURONIAN-CONIACIAN STAGE

Inoceramus deformis-Scaphites preventricosus zone:

Jeletzky stated that this zone is present in the Upper Cardium and the lower 80 feet of the Wapiabi, and indicated that it was most fossiliferous between 50 and 80 feet above the base of the latter. It lies beneath the Badheart formation in the upper Kaskapau shale of the Smoky River group in the Peace River area (Stelck, 1955). The exact age of the zone is uncertain, but is probably lowermost Coniacian and uppermost Turonian (Webb and Hertlein, 1934). Inoceramus deformis is found in the Turonian I. schloenbachi zone of Europe. It has not been reported from the I. koeneni zone, the European equivalent of the upper

TABLE 2

CORRELATION CHART OF THE CANADIAN WESTERN INTERIOR TURONIAN-LOWER CAMPANIAN

STAGES AND SUBSTAGES		EUROPEAN ZONES AND SUBZONES: AMMONITES ZONES AND SUBZONES		EUROPEAN ZONES AND SUBZONES: BELEMNITES	EUROPEAN ZONES AND SUBZONES: INOCERAMUS	EUROPEAN ZONES AND SUBZONES: ECHINODERMS	CANADIAN WESTERN INTERIOR ZONES AND SUBZONES	U.S WESTERN INTERIOR ZONES AND SUBZONES
CAMPANIAN	LOWER	Scaphites binodosus and Scaphites hippocrepis	Pachydiscus dulmensis and Scophites aquisgranensis	Belemnitella praecursor s lato: Gonioteuthis quadrata var gracilis	?	Offaster corculum	?	Scaphites hippocrepis
						Offaster pilula	Scaphites hippocrepis	
			Placenticeras (Diplacmoceras) bidorsatum and Hauericeras pseudogardeni	Gonioteuthis quadrata f typ	Inoceramus of the Inoceramus cardissoides lobatus stenstrupi species group	?		
				Gonioteuthis granulata — quadrata and Gonioteuthis granulata f typ		?		
SANTONIAN		Placenticeras syrtale		Gonioteuthis granulata f ant		Marsupites ornatus	Inoceramus of the Inoceramus cardissoides – lobatus – stenstrupi species group and Baculites anceps	Scaphites (Desmoscaphites) bassleri
				Gonioteuthis granulata – westfalica		Uintacrinus westfolicus	Scaphites (Desmoscaphites) spp	Scophites (Desmoscaphites) erdmanni
		Placenticeras cf guadalupae and Placenticeras clypeole	Placenticeras cf guadalupae	Actinocamax westfolicus and Belemnitello ex gr mirabilis Arch	Inoceramus cardiformis and variants	Micraster coranguinum	?	Scophites (Cliascaphites) choteauensis
			Parapuzosia corbarica				Scaphites (Clioscaphites) montanensis and Inoceramus cardiformis s lato	Scaphites (Cliascaphites) vermifarmis
		Texonites texonus		Belemnitello propinqua				
CONIACIAN		Texonites emocheris		Actinocamax lundgreni	Inoceramus undulata – plicatus		Scaphites depressus	Scophites depressus
		Texanites (Barraisiceras) haberfellneri	Gauthiericeras margae		Inoceramus involutus s lato and variants	Microster cortestudinarium	Inoceramus involutus (= I umbonatus) and variants and Scaphites ventricosus	Scaphites ventricasus
			Prionocycloceras guyabanum					
			Borrolsiceras nicklesi					
			Barraisiceras haberfellneri					
			Texanites (Peroniceros) subtricarinotum		Inoceramus koenen		Inoceramus deformis and Scaphites praeventricosus	Inoceramus deformis and Scophites praeventricosus
TURONIAN		Pseudojacobites formeryi		Actinocamax Strehlensis	Inoceramus schloenbochi	Holaster planus	Inoceramus lamarcki s lato and Prionotropis zone: UNNAMED ZONE	Scaphites corvensis
			Hyphantoceras reussanum					Scophites nigricollensis
			Prionocyclus neptuni					Prionocyclus (Prionocyclus) wyomingensis
		Prionocyclus (Callignoniceras) woolgari	Coilopoceras requienianum		Inoceramus lamarcki s lato	?		Scaphites warreni
			Romoniceras deverianum					Prionocyclus (Prionocyclus) hyatti
			Romoniceras ornatissimum				Prionocyclus (Callignoniceras) woolgari s lato	Prionocyclus (Calligniceras) woolgari
			Prionocyclus (Callignoniceras) woolgari					
		Mammites nodosoides	Vascoceras sp		Inoceramus labiatus		Watinoceras and Inoceramus labiatus	Inoceramus labiatus
			Mammites nodosoides				Watinoceras reesider and Inoceramus labiatus	
		Fagesia superstes	Pseudaspidoceras footeanum				Baculites (Sciponoceras) cf gracile and Prionocyclus (Calligniceras) n sp	Baculites (Scipanoceras) gracile
			Fagesia supersles					
		Metoicoceros patteri		Actinocamax planus	?		Inoceramus aff, I. fragilis	? ? ?
			Acanthoceras vicinale				Dunvegonoceras cf conditum	

G.S.C AFTER JELETZKY

part of I. deformis-Scaphites preventricosus zone, but its time span must be represented in this zone because the next youngest zone, I. involutus-S. ventricosus, occurs immediately above.

Scaphites preventricosus is present within 100 feet of the base of the Wapiabi, and Inoceramus deformis within 60 feet of the base on Oldfort Creek. Inoceramus deformis was found 146 feet above the base on Mill Creek. Therefore, this zone may extend slightly higher in the Wapiabi formation than indicated by Jeletzky (1956).

Inoceramus involutus-Scaphites ventricosus zone:

Although this zone is most fossiliferous from 100 to 250 feet above the base of the Wapiabi formation, it occurs locally in the top beds of the Cardium formation, suggesting that the Cardium-Wapiabi contact is possibly diachronic (Jeletzky ibid.). In the Peace River area, the zone is present in the uppermost Kaskapau beds immediately below the Badheart sandstone, but S. ventricosus is also reported from the Badheart sandstone with Clioscaphites montanensis (Stelck, 1955).

Jeletzky (1956) stated that Inoceramus umbonatus Meek and Hayden is a morphological variation of I. involutus, thus the zone is considered Middle Coniacian.

Inoceramus sp., cf. I. umbonatus was found on Oldfort Creek from 250 to 395 feet above the base of the Wapiabi. Scaphites ventricosus was obtained on Mill Creek 200 feet above the base, and an immature specimen, thought to belong to this species, was found in the Platy Shale member 525 feet above the base on Oldfort Creek. Scaphites ventricosus extends into other defined zones such as Clioscaphites montanensis.

Scaphites depressus zone:

This zone immediately follows the Inoceramus involutus and Scaphites ventricosus zone in the Canadian western interior. The zonal index is most abundant in that part of the Lower Concretionary member lying from 250 to 300 feet above the base of the Wapiabi formation, but also may be found as low as the Upper Cardium or as high as the Lower Badheart.

Scaphites depressus occurs in the middle part of the Lower Concretionary member on Ram River, thus verifying the position given by Jeletzky (1956).

SANTONIAN STAGE

Upper and lower boundaries of the Santonian stage are difficult to place, because index fossils such as Uintacrinus, Marsupites and Desmoscaphites are extremely rare in the Canadian western interior. The lower boundary is tentatively placed below the Platy Shale member in the upper beds of the Lower Concretionary member (Jeletzky ibid.).

Warren and Rutherford (1928) introduced the now generally used Baculites ovatus zone for marine "Upper Colorado" (Wapiabi) rocks of Santonian age. The time range of the zonal index is extensive and used only for approximate dating of strata in the Canadian western interior.

Clioscaphites montanensis-Inoceramus cordiformis zone:

This zone, coextensive with the uppermost beds of the Lower Concretionary member and the lower beds of the Platy Shale member of the Wapiabi, is also present in the Badheart sandstone. It corresponds to the United States western interior zone of Clioscaphites vermiformis

TABLE 3

CORRELATION CHART OF UPPER TURONIAN TO LOWER CAMPANIAN ROCKS OF THE WESTERN INTERIOR

STAGES & SUBSTAGES	CANADIAN WESTERN INTERIOR ZONES	MONTANA		NORTH DAKOTA	SOUTH-CENTRAL FOOTHILLS	SOUTHERN PLAINS	NORTH-CENTRAL FOOTHILLS	CENTRAL PLAINS	NORTH-WEST PLAINS
LOWER CAMPANIAN	SCAPHITES HIPPOCREPIS	MONTANA GROUP	EAGLE Ss / VIRGELLE Ss.	PIERRE SHALE	BELLY RIVER FM.	MILK RIVER Ss	BRAZEAU FM	LEA PARK FM.	
SANTONIAN	OESMOSCAPHITES SP		TELEGRAPH CREEK FM		TRANSITION / HIGHWOOD Ss MEMBER	"TELEGRAPH CREEK" FM	TRANSITION MEMBER / SOLOMON Ss.		CHINOOK Ss. / WHITE SPECKS ZONE
	?		OARK SHALE MEMBER	NIOBRARA FM	UPPER CONCRETIONARY MEMBER	1st. WHITE SPECKS ZONE	UPPER CONCRETIONARY MEMBER		"WAPIABI SHALE"
	CLIOSCAPHITES MONTANENSIS	COLORADO GROUP			WAPIABI SHALE: PLATY SHALE MEMBER	"COLORADO SHALE"	WAPIABI SHALE: PLATY SHALE MEMBER	" COLORADO SHALE"	BADHEART Ss.
CONIACIAN	SCAPHITES OEPRESSUS				LOWER CONCRETIONARY MEMBER		LOWER CONCRETIONARY MEMBER		SMOKY RIVER GROUP
	SCAPHITES VENTRICOSIS								
	SCAPHITES PREVENTRICOSUS								KASKAPAU SHALE
UPPER TURONIAN	UNNAMED ZONE		SANDY SHALE MEMBER	CARLILE FM.	CARDIUM FM. / BLACKSTONE SHALE		CARDIUM FM. / BLACKSTONE SHALE		

(Cobban and Reeside, 1952).

Jeletzky (1956) used Inoceramus cordiformis Sowerby s.l., which seems to be restricted to this zone, as a second zonal index. Other inocerami, of the zone, have longer ranges and are found in both under- and overlying zones. Inoceramus lundbreckensis McLearn, and Baculites ovatus Say and varieties make their first appearance here.

Inoceramus cordiformis is diagnostic of the Lower Santonian Texanites texanus-Placenticeras cf. guadalupe zone of western and northwestern Europe, thus the age of the S. (C.) montanensis-I. cordiformis zone is considered the same.

Clioscaphites montanensis was collected near the top of the Lower Concretionary member on Cardinal River and Thistle Creek, thus indicating that the Santonian boundary should be placed below the Platy Shale member. Baculites ovatus occurs just below Uintacrinus sp.? in the middle third of the Platy Shale member on Thistle Creek, and with C. montanensis on Cardinal River.

Jeletzky (1956) stated that there is no defined zone, which corresponds to the Clioscaphites choteauensis zone of the United States in the Canadian western interior.

Desmoscaphites zone:

This zone occurs in the upper part of the Platy Shale member in the central foothills, and extends at least to the top of the Transition member. It is associated with rare Scaphites leei, numerous inocerami of the lobatus-cardissoides-stenstrupi (= I. lundbreckensis) group, and various Baculites.

In the United States western interior, Cobban and Reeside (1952) reported Desmoscaphites bassleri from the Telegraph Creek formation, which Russell and Landes (1940) correlated with the Transition member.

Jeletzky (1956) defined the Desmoscaphites zone as the approximate equivalent of the Baculites ovatus zone as used by Webb and Hertlein (1934) and Gleddie (1954). He proposed placing the Santonian-Lower Campanian boundary at the top of this zone because of the recent discovery of a Scaphites hippocrepis immediately above it in the Lea Park formation of the Lower Athabasca River area. The Desmoscaphites zone is thus regarded as Upper Santonian.

The Lower Campanian substage is represented by the Scaphites hippocrepis zone and occurs in the Eagle sandstone immediately above the Telegraph Creek formation in the United States western interior. It is also recognized near the base of the Lea Park formation in east-central Alberta, thus Jeletzky (1956) indicated that the Santonian-Lower Campanian boundary is close to the first or upper white-speckled shale zone.

CHAPTER FOUR

INTERPRETIVE GEOLOGY

Thickness Variations

The Wapiabi formation, which can be traced throughout the central and southern foothills, is thicker along the western limits of the foothills belt. Field observations, in the north-central foothills, on Thistle Creek (locality 1), and Cardinal River (locality 2), and measurements by Stott (1956) on Thistle Creek (locality 5), show that thickness changes in the Lower Concretionary Shale sub-member, Platy Shale member and Upper Concretionary Shale sub-member account for nearly all the gross thickening of the formation towards the west. The same three divisions account for nearly all the marked thinning of the total formation towards Blackstone River.

The Platy Shale member accounts for almost the total difference in thickness between the Oldfort Creek and Ghost River sections. At Gulf Triad et al Rocking "P" well, thickening in the Upper Concretionary and Transition members is possibly accounted for by some repetition.

In the north-central foothills, shortly before Platy Shale time, large quantities of material began entering the Wapiabi sea. The sea was driven out towards the east, and rivers draining the region to the north and north-west deposited clay and silt into the sea, after crossing the emergent coastal plain. Following the above reasoning, it can be postulated that the emergent coastal plain, in the region of Oldfort Creek, did not affect the pattern of deposition

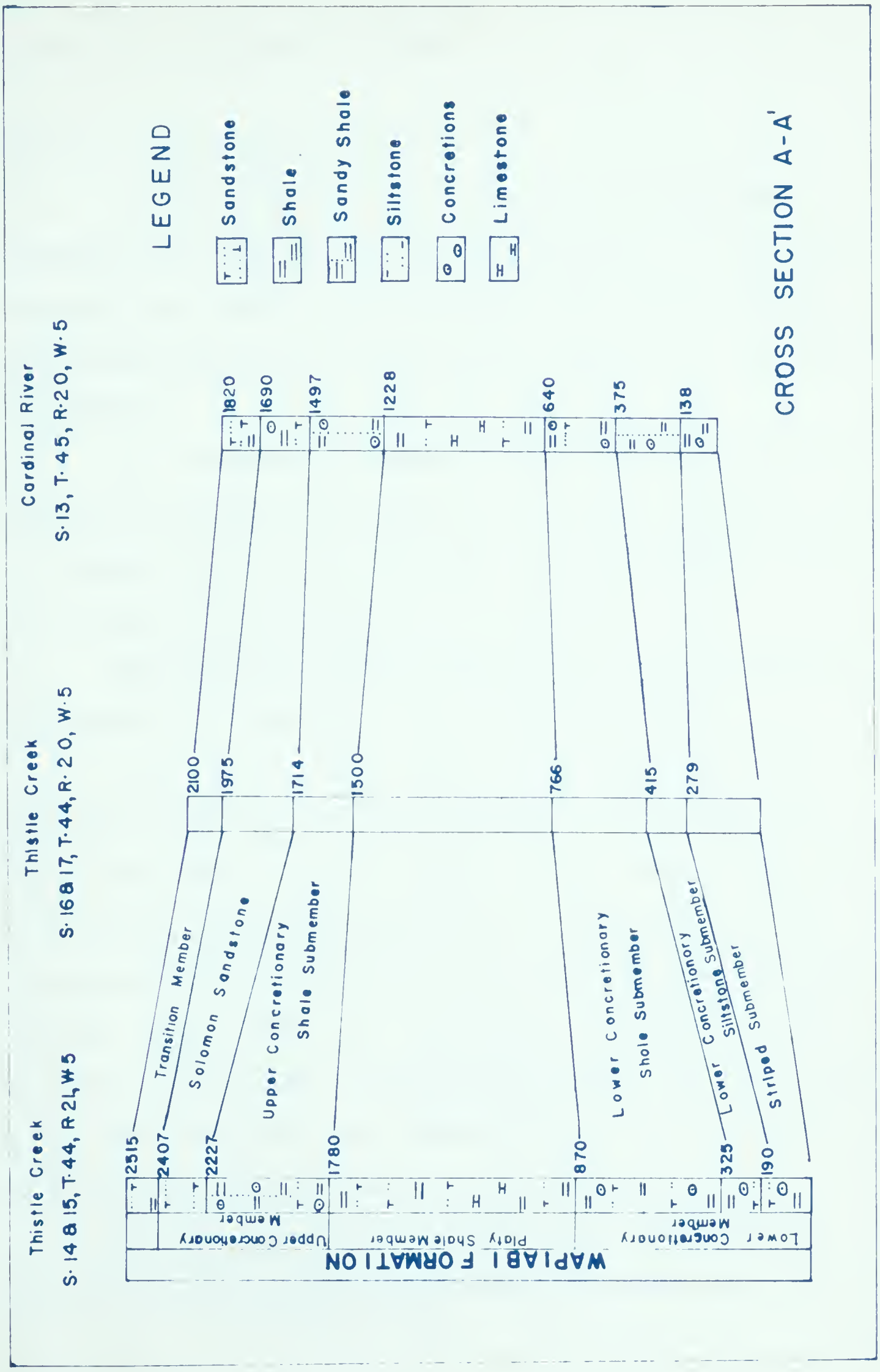

CROSS SECTION A-A'
LEGEND
Sandstone
Shale
Sandy Shale
Siltstone
Concretions
Limestone
Cardinal River
S-13, T-45, R-20, W-5
Thistle Creek
S-16 & 17, T-44, R-20, W-5
Thistle Creek
S-14 & 15, T-44, R-24, W-5
WAPIABI FORMATION
Upper Concretionary Member
Platy Shale Member
Lower Concretionary Member
1820
1690
1497
1228
640
375
138
2100
1975
1714
1500
766
415
279
2315
2407
2227
1780
870
325
190
Transition Member
Solomon Sandstone
Upper Concretionary Shale Submember
Lower Concretionary Shale Submember
Lower Concretionary Siltstone Submember
Striped Submember

Figure 2

until the beginning of Platy Shale time, when coarser clastic sediments were introduced to the sea.

Divisions of the Formation

All members of the Wapiabi formation are recognizable throughout the central foothills, but on Mill Creek in the southern foothills, the calcareous nature of the Upper Concretionary Shale member is more suggestive of the subsurface expression of the "First White Specks".

All sub-members are better developed in the north-central foothills, and contacts are generally well-defined. Sub-members are not recognized in the Lower Concretionary member on Oldfort Creek or in the Upper Concretionary member on Mill Creek.

The subdivision of the formation into rock units, which can not be traced far laterally, is only significant locally.

In the north-central foothills, the Upper Concretionary Siltstone sub-member is an easterly extension of the Solomon sandstone. The Solomon is well developed on Thistle Creek (locality 1) but is silty and shaly on Cardinal River to the north-east. Field observations seem to indicate that the Solomon is separate from the Transition member. The Solomon sandstone may represent an offshore bar built up as the coastal plain became emergent. The sand, brought in by rivers draining a rising land mass to the west and north-west, may be winnowed phases of tongues extending out from deltas.

The Highwood sandstone is defined as a buff weathering, fine, hard sandstone containing ironstone concretions, and is best

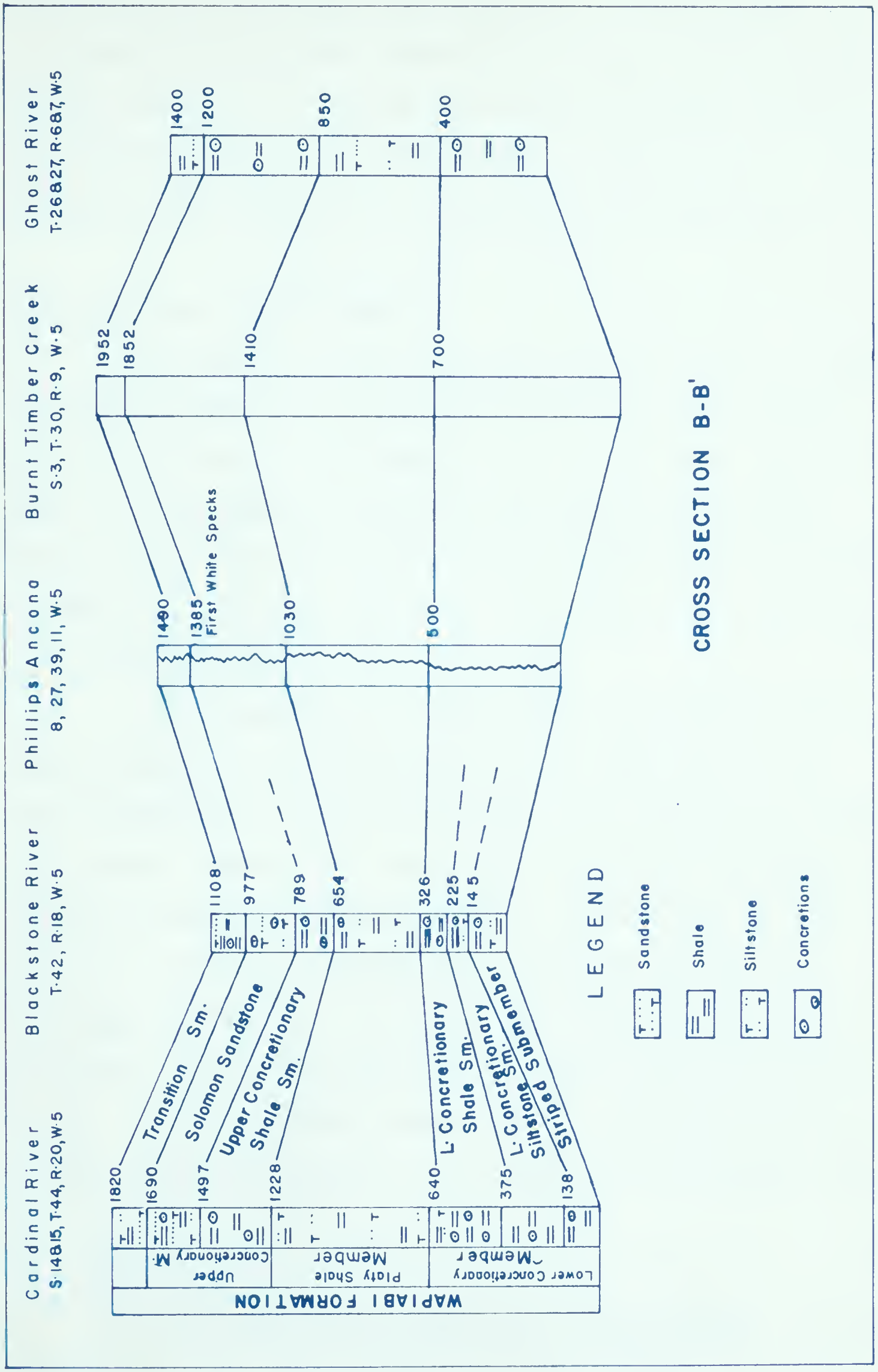

Cardinal River
S·14&15, T·44, R·20, W·5
Blackstone River
T·42, R·18, W·5
Phillips Ancona
8, 27, 39, 11, W·5
Burnt Timber Creek
S·3, T·30, R·9, W·5
Ghost River
T·26&27, R·6&7, W·5
WAPIABI FORMATION
Upper Concretionary Mbr.
Platy Shale Member
Lower Concretionary Member
Transition Sm.
Solomon Sandstone
Upper Concretionary Shale Sm.
L. Concretionary Shale Sm.
L. Concretionary Siltstone Submember
Striped Submember
First White Specks
1820
1690
1497
1228
640
375
138
1108
977
789
654
326
225
145
1400
1385
1030
500
1952
1852
1410
700
1400
1200
850
400
LEGEND
Sandstone
Shale
Siltstone
Concretions
CROSS SECTION B-B'

Figure 3

known from the Turner Valley area south-west of Oldfort Creek. A sandstone fitting the above description is present on Oldfort Creek either near the top of the Upper Concretionary Siltstone sub-member or in the Transition member. Further work on this section is required before the exact position of this sandstone can be established.

The Solomon and Related Sandstone

The Solomon has been correlated with the Milk River, Highwood and Chinook sandstones. This correlation may or may not be exactly right, but all were possibly derived from an uplifted land mass to the west. The four sandstone units do represent the beginning of a change from marine to continental deposition, and represent the shift in lithotopes during successive times, as various parts of the coast line became emergent.

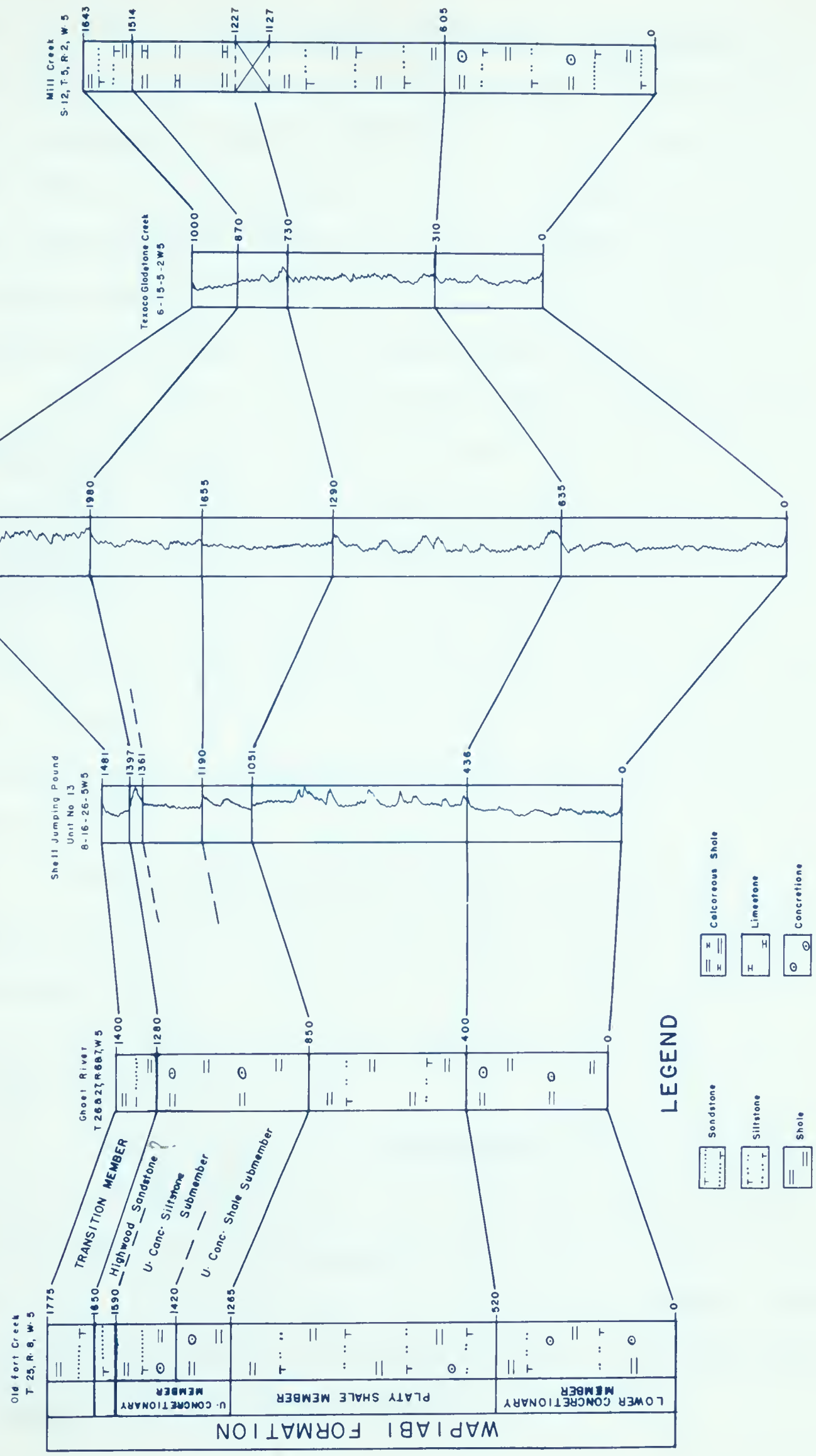
The Solomon, which is separate from the Transition member, might represent continual deposition from the Upper Concretionary Shale sub-member to the Transition member, and is probably an offshore bar deposit. However, the three remaining sandstones are present within the Transition member, and vary in thickness from zero to 100 feet. The Highwood and Milk River sandstones may have been deposited as basal sands as the shore line fluctuated east-west, and represent disconformities; this may also apply to the Chinook sandstone. Cobban et al (1959) indicated that an unconformity may be present beneath the Telegraph Creek formation in the Sweetgrass arch.

The Faunal Zones

Field observations on Mill Creek, in the southern foothills,

Figure 4

CROSS SECTION C-C'



indicate that the Inoceramus deformis-Scaphites preventricosus zone extends as high as 150 feet above the base of the Wapiabi formation, since I. deformis is found this high in the section. Representatives of the zone were not found higher than this, and workers in the field report the occurrence of the zone from lower horizons. No fossils of the zone were found in the upper beds of the Cardium formation, but Jeletzky (1956) mentioned that S. preventricosus has been collected here.

Zonal indices of the Inoceramus involutus-Scaphites ventricosus and Scaphites depressus zones were collected where they were expected to occur with one exception. An immature Scaphites, thought to be S. ventricosus, was collected from the base of the Platy Shale member. Jeletzky reported representatives of both zones from as low as the upper beds of the Cardium formation, but did not indicate the locality. These occurrences would be low for both zones and it is suggested that they were collected from sands in the Lower Wapiabi and not from true Cardium.

The Clioscaphites montanensis-Inoceramus cordiformis zone is present in the upper beds of the Lower Concretionary Shale sub-member on Cardinal River and near the base of the Platy Shale member on Thistle Creek. Workers also report these occurrences indicating that the zone is clearly defined.

A fossil thought to be a Desmoscaphites was collected from near the top of the Platy Shale member in a road outcrop north of Burmis. Jeletzky stated that the Desmoscaphites zone begins in the Platy Shale member and may go as high as the top of the Transition member. Wapiabi sections where this zone is fossiliferous have yet to be found before the boundaries of the zone can be defined.

CHAPTER FIVE

PALAEONTOLOGY

INTRODUCTION

One crinoid, twenty pelecypods, one gastropod and fourteen ammonites are described. All but one ammonite and one pelecypod are illustrated.

FORMAL DESCRIPTIONS

Phylum ECHINODERMA

Class CRINOIDEA

Subclass uncertain

Suborder ARTICULATA

Family UINTACRINIDAE

Genus UINTACRINUS Grinnel, 1876

Uintacrinus sp.?

Plate 7, figure 1.

Description: From one broken specimen; figured specimen No. JW-59-3-130G.

The specimen consists of plates from several broken arms, and each plate is shaped like a three-quarter moon. The arms are at least six inches long.

Measurements: The greatest diameter of a single plate is 3 mm.

Types: Figured specimen, Research Council of Alberta No. JW-59-3-130G.

Horizon: Talus from the middle third of the Platy Shale member about 370 feet above its base. This is about 25 feet above the first limestone band in the Platy shale.

Locality: Thistle Creek, section 1, unit 10, S. 14 and 15, T. 44, R. 21, W5.

Remarks: Warren and Crockford (1948) described Uintacrinus socialis from Alberta. Their specimen was found in the lower half of the Platy Shale member on Oldfort Creek.

Phylum MOLLUSCA

Class PELECYPODA

Order PRIONODESMACEA

Superfamily PTERIACEA

Genus INOCERAMUS Sowerby, 1814

Inoceramus deformis Meek

Plate 3, figures 7, 8.

Inoceramus deformis Meek, 1871, Ann. Rept. U.S. Geol. Surv. Terr. for 1870, p. 296.

Haploscapha capax Conrad, 1874, Ann. Rept. U.S. Geol. Surv. Terr. for 1873, p. 456.

Inoceramus deformis Meek, 1877, U.S. Geol. Expl. Fortieth Parallel, Vol. 4, Pt. 1, p. 146, pl. 14, figs. 4a, b.

Inoceramus deformis Meek. Stanton, 1893, U.S. Geol. Surv. Bull. 106, p. 85, pl. 14, fig. 1; pl. 15, figs. 1, 2.

Description: From one adult specimen; hypotype, No. JW-59-7-18a.

The right valve is large, higher than long, obliquely ovate and fairly well inflated. The beak is situated near the anterior margin and is slightly incurved. The hingeline is short. Both posterior and ventral margins are broadly rounded; the ventral margin curves

quite sharply into the anterior margin indicating obliqueness of the shell. Umbonal slopes are fairly steep in both dorso-anterior and dorso-posterior regions. The surface is ornamented with strong, sharp concentric undulations or ridges which rapidly decrease in size near the umbo. The ornament curves sharply towards the anterior and rather evenly towards the posterior.

Measurements: The figured adult specimen is about 80 mm. high and about 65 mm. long.

Types: Hypotype, Research Council of Alberta No. JW-59-7-18a.

Horizon: From limestone concretions in a shale bed, 140 feet above the base of Lower Concretionary Member.

Locality: Mill Creek, section 4, unit 2, S. 12, T. 5, R. 2, W.5.

Remarks: Two young examples and one adult specimen were examined, and the margins of all are obscured. The ornamentation, position of beak and size of shell make identification possible.

Inoceramus sp., cf. I. deformis Meek

Plate 4, figure 6.

cf. Inoceramus deformis Meek. Stanton, 1893, U.S. Geol. Surv., Bull. 106, p. 85, pl. 14, fig. 1; pl. 15, figs. 1, 2.

Description: From an external cast of one specimen, which is figured; No. JW-59-2-11c.

The left valve is of medium size, slightly higher than long, moderately convex and slightly inflated. The beak is slightly incurved and is situated between the middle and anterior of the valve. The shell is ovate in outline; the posterior and anterior margins curve evenly into the ventral margin. There are irregularly placed, fairly

strong concentric undulations over the left valve, which become markedly weaker in the umbonal region. An occasional growth line is present between undulations.

Measurements: The figured specimen is 54 mm. high and 49 mm. long.

Types: Figured specimen, Research Council of Alberta No. JW-59-2-11c.

Horizon: A shale bed 150 feet above the base of the Lower Concretionary member.

Locality: Oldfort Creek, section 3, unit 2, T. 25, R. 8, W.5.

Remarks: The specimen resembles I. deformis Meek except for its smaller size and weaker, more rounded ornament.

Inoceramus undabundus Meek and Hayden

Plate 3, figure 6.

Inoceramus undabundus Meek and Hayden, 1862, Proc. Acad. Nat. Sci. Phila., p. 26.

Inoceramus undabundus Meek and Hayden. Stanton, 1893, U.S. Geol. Surv., Bull. 106, p. 84, pl. 16, figs. 1, 2.

Description: From the one specimen collected; hypotype, No. JW-59-2-2a.

The shell is obliquely rhombic, higher than long, large, obese and has a prominent anterior, left beak. It is very well inflated in the latero-umbonal area and is broadly convex towards the ventor. The umbonal axis makes an angle of about 70 degrees with the hingeline. Anterior and dorsal planes converge at an angle of about 90 degrees. The left valve is well marked by concentric undulations having quite sharply rounded crests and broadly curved troughs in between. Nature of concentric undulations suggests a semicircular ventral margin.

Measurements: The specimen is about 95 mm. high and about 72 mm. long.

Types: Hypotype, Research Council of Alberta No. JW-59-2-2a.

Horizon: A shale bed 52 feet above the base of the Lower Concretionary member.

Locality: Oldfort Creek, section 3, unit 1, T. 25, R. 8, W.5.

Remarks: The pronounced left beak and obesity are very characteristic of I. undabundus Meek and Hayden.

Inoceramus sp., aff. I. undabundus Meek and Hayden

Plate 4, figure 7.

Description: From a fragment of latero-umbonal regions including beak; figured specimen No. JW-59-2-32B.

The shell is well inflated, and has an incurved beak on the left valve. The anterior and dorsal margins are both concave. Small concentric undulations are present in the umbonal area.

Measurements: The figured specimen is at least 55 mm. long; convexity of left valve is about 30 mm. in the umbonal region.

Types: Figured specimen, Research Council of Alberta No. JW-59-2-32B.

Horizon: From a shale bed 295 feet above base of the Lower Concretionary member.

Locality: Oldfort Creek, section 3, unit 2, T. 25, R. 8, W.5.

Remarks: The beak resembles that of Inoceramus undabundus Meek and Hayden, but there are no indications of strong ornamentation in the umbonal region.

Inoceramus exogyroides Meek and Hayden

Plate 4, figures 3, 4.

Inoceramus exogyroides Meek and Hayden, 1862, Proc. Acad. Nat. Sci., Phila., p. 26.

Inoceramus exogyroides Meek and Hayden. Meek, 1876, U.S. Geol. Surv. Terr., Vol. 9, p. 46, pl. 5, figs. 3a-c.

Inoceramus exogyroides Meek and Hayden. Stanton, 1893, U.S. Geol. Surv., Bull. 106, p. 83, pl. 17, figs. 1, 2.

Description: From 5 left valves in an ironstone concretion; hypotypes, No's. JW-59-3-43A-E.

The cast of the left valve is quite large, slightly higher than long, very well inflated, subcircular in outline and obese. The beak is strongly incurved and is twisted forward to nearly parallel the hingeline. Latero-umbonal slopes are very steep. The surface is ornamented with weak, concentric growth lines.

Measurements: No true measurement obtained but one specimen is about 70 mm. high and 60 mm. long.

Types: Figured hypotype, Research Council of Alberta No. JW-59-3-43A.

Horizon: From a band of concretions occurring at the top of the Striped sub-member, 180 feet above the base of the Wapiabi formation.

Locality: Thistle Creek, Section 1, unit 3, S. 14 and 15, T. 44, R. 21, W.5.

Remarks: All the specimens are small for the species, but the distinctive beak and obese left valve make identification possible.

Inoceramus sp. cf. I. umbonatus Meek and Hayden

Plate 5, figures 7, 8.

cf. Inoceramus umbonatus Meek and Hayden. Stanton, 1893, U.S. Geol. Surv., Bull. 106, p. 81, pl. 18, figs. 1, 2.

Description: From two external molds of left valves; figured specimens, No's. JW-59-2-47A,B.

The left valve is well inflated, subrounded and quite large. The beak is very prominent, elevated, incurved, and the point is nearly terminal. The umbo is large and prominent; post umbonal slopes are steep. The hinge line is slightly convex dorsally. The posterior margin is nearly straight to slightly concave and curves quite sharply into the ventral margin. Widely spaced, shallow, concentric undulations are present on some specimens.

Measurements: The figured specimen is 69 mm. high, 54 mm. long.

Types: Figured specimen, Research Council of Alberta No. JW-59-2-47B.

Horizon: A shale bed 395 feet above the base of Lower Concretionary member; other specimens from 295 to 395 feet above the base.

Locality: Oldfort Creek, section 3, units 3, 4, T. 25, R. 8, W.5.

Remarks: The specimens are not as obese as I. umbonatus Meek and Hayden and do not have such a strongly involute beak as some previously figured specimens. The prominent beak and shape compare with the species, though.

Inoceramus sp., cf. I. selwyni McLearn

Plate 4, figure 9; plate 7, figure 2.

cf. Inoceramus selwyni McLearn, 1926, Geol. Surv. Can., Bull. 42, p. 122, pl. 21, figs. 8, 9.

Description: From one specimen, of two that were collected; both figured, No's. JW-59-2-32 A, 60.

The specimen is fairly small, nearly equivalved, the left valve being slightly larger and more obese. The hinge line is nearly

as long as the specimen is high. Beaks and umbones are both prominent. The posterior margin is rounded below and concave above into the dorsal margin. The anterior margin is evenly curved and inclined inward above. The right valve is ornamented with fairly strong concentric undulations and sharp growth lines. The left valve is a cast but apparently is ornamented much the same.

Measurements: None available.

Types: Figured specimens, Research Council of Alberta No's. JW-59-2-32A, 60.

Horizon: A shale bed 527 feet above base of Wapiabi formation at the base of the Platy Shale member.

Locality: Oldfort Creek, section 3, unit 6, T. 25, R. 8, W.5.

Remarks: The described specimen (pl. 7, fig. 2) resembles I. selwyni McLearn but cannot be definitely compared since part of the posterior and ventral margins are missing. A beak of a much larger specimen (pl. 4, fig. 9) also resembles this species with respect to its shape and position.

Inoceramus sp., cf. I. coulthardi McLearn

Plate 6, figure 7.

cf. Inoceramus coulthardi McLearn, 1926, Geol. Surv. Can., Bull. 42, p. 121, pl. 21, figs. 1-4.

Description: From one specimen which is figured; No. JW-59-4-41E.

This specimen is higher than long, sub-ovate to subquadrate, well inflated, and is quite small. It has a prominent umbo and post-umbonal slope. The beak of the left valve is twisted forward, anterior and incurved. The anterior margin is straight to slightly concave, and slightly flattened. Moderate, concentric undulations are present which

indicate a fairly gentle curvature of the ventral margin into anterior margin.

Measurements: The figured specimen is about 60 mm. high and 40 mm. long.

Types: Figured specimen, Research Council of Alberta No. JW-59-4-41E.

Horizon: A talus slope in a side gully 480 feet above the base of the Wapiabi formation, near the top of the Lower Concretionary Shale sub-member.

Locality: Cardinal River, section 2, unit 6, S. 13, T. 45, R. 20, W.5.

Remarks: The specimen is similar to I. coulthardi McLearn, but a definite comparison is not possible since the beak could not be extracted from concretionary material.

Inoceramus sp., cf. I. pontoni McLearn

Plate 3, figures 4 & 5.

cf. Inoceramus pontoni McLearn, 1926, Geol. Surv. Can., Bull. 42, p. 121, pl. 20, figs. 1, 2.

Description: From one small specimen; figured, No. JW-59-2-11D.

The shell is higher than long, well inflated and subquadrate in outline. The postumbonal slope is rounded and very prominent. A well developed beak is anterior and makes an angle of 70 degrees with the hinge-line. The anterior margin is vertically truncated, straight, flat and is perpendicular to the hingeline. Ventral and posterior margins are rounded. Ornament consists of strong concentric corrugations with growth lines in the interspaces.

Measurements: The specimen is 87 mm. high and about 65 mm. long.

Types: Figured specimen, Research Council of Alberta No. JW-59-2-11D.

Horizon: A shale bed 150 feet above the base of the Lower Concretionary member.

Locality: Oldfort Creek, section 3, unit 2, T. 25, R. 8, W.5.

Remarks: The specimen resembles I. pontoni McLearn, but has coarser ornamentation. The described example is a right valve; a larger left valve, which has the same characteristics, was found near the top of the Lower Concretionary member on Fallentimber Creek, S. 28, T. 29, R. 8, W.5.

Inoceramus sp.

Plate 8, figure 9.

Description: From four specimens from one concretion; No's. JW-59-5-4D-G. The shell is large, subrounded-subtriangular, deflated and has a terminal beak. The dorso-anterior margin is concave and extended so that the specimen is nearly as long as high. The ventral margin is broadly rounded and curves sharply to meet both anterior and posterior margins. The beak makes an angle of 10 to 15 degrees with the hingeline. The ornament consists of low concentric undulations and growth rings. Young specimens are well inflated.

Measurements: Four specimens are from 54 to 115 mm. high and 52 to 112 mm. long.

Types: Figured specimen, Research Council of Alberta No. JW-59-5-4G.

Horizon: A limestone concretion near the top of the Platy Shale member.

Location: From a road exposure 8 miles north of Burmis, S. 11, T. 9, R. 2, W.5.

Remarks: The distinct outline suggests a new species.

Inoceramus lundbreckensis McLearn

Plate 8, figure 7.

Inoceramus lundbreckensis McLearn, 1929, Nat. Mus. Can., Bull. 58, p. 77, pl. 15, fig. 4; pl. 16, fig. 2 (non pl. 17, fig. 1).

Description: From one specimen retaining shell material; hypotype, No. JW-59-3-130A.

The hypotype consists of a left valve of a large specimen. It is oblique, moderately inflated and much higher than long. Maximum convexity occurs along the post-umbonal slope. A broad depression or furrow radiates from above the postumbonal slope; a ridge is present above the furrow or along the postero-dorsal submargin. The shell is ornamented with quite sharp concentric ridges which become markedly reduced in the umbonal region. There are concentric growth lines between the ridges.

Measurements: None available.

Types: Hypotype, Research Council of Alberta No. JW-59-3-130A.

Horizon: From an ironstone-limestone concretion 1208 feet above base of Wapiabi formation, in the Platy Shale member.

Location: Thistle Creek, section 1, unit 10, S. 14 and 15, T. 44, R. 21, W. 5.

Inoceramus sp., cf. I. lundbreckensis McLearn

Inoceramus cf. lundbreckensis McLearn, 1929, Nat. Mus. Can., Bull. 58, p. 78, pl. 17, fig. 1 (non pl. 15, fig. 4; pl. 16, fig. 2).

Description: From one fragmental specimen; No. JW-59-7-92J.

The shell is quite large, oblique, higher than long and gently

convex. A shallow sulcus is present along the post-umbonal slope. The surface is marked by widely spaced shallow concentric undulations and evenly spaced growth lines.

Measurements: None available.

Types: Described specimen, Research Council of Alberta No. JW-59-7-92J.

Horizon: From a fossiliferous bed of calcareous shale near the base of the Upper Concretionary member of the Wapiabi formation. The shale bed is about 1370 feet above the base of the formation.

Locality: Mill Creek, section 4, unit 12, S. 12, T. 5, R. 2, W.5.

Remarks: Specimen is a cast of the left valve. The above description compares with the one by McLearn and his illustration is nearly identical with the specimen on hand.

Genus PTERIA Scopoli 1777

Pteria sp.

Plate 8, figure 8.

Description: From an external mold; figured specimen, No. JW-59-7-94C.

The shell is small, slightly longer than high, and subovate in outline. The beak is offset somewhat towards the anterior. The anterior wing is shorter than the posterior wing and is separated from the main shell by a very shallow furrow running parallel to the anterior margin. The ventral margin is semicircular in outline. Post umbonal slopes are gentle. Radial ribs are prominent on the surface and run straight back from the beak. Very fine, closely spaced concentric growth lines are present.

Measurements: The right valve is 13 mm. high and 14 mm. long.

Types: Figured specimen, Research Council of Alberta No. JW-59-7-94C.

Horizon: A calcareous shale bed 1370 feet above the base of the Wapiabi formation, near the base of the Upper Concretionary member.

Locality: Mill Creek, section 4, unit 12, S. 12, T. 5, R. 2, W.5.

Superfamily OSTRACEA

Genus OSTREA Linnaeus 1758

Ostrea congesta Conrad

Plate 8, figure 4.

Ostrea congesta Conrad, 1843, Nicollet's Rept. of Explns. in the N.W., p. 167.

Ostrea congesta Conrad. Hall, 1856, Pac. R.R. Repts., vol. 3, p. 100, pl. 1, fig. 11.

Ostrea congesta Conrad. Meek, 1876, U.S. Geol. Surv., vol. 9, p. 13, pl. 9, figs. 1a-f.

Ostrea congesta Conrad. White, 1884, Ann. Rept. U.S. Geol. Surv., p. 294, pl. 39, figs. 11-13.

Ostrea congesta Conrad. Stanton, 1893, U.S. Geol. Surv., Bull. 106, p. 55, pl. 2, figs. 2-4.

Description: From the cast of a lower valve; hypotype, No. JW-59-7-92H.

This valve is elongated, ventricose and irregular. The umbo is truncated by the mark of adhesion; the shell is thin and apparently has a smooth surface.

Types: Hypotype, Research Council of Alberta No. JW-59-7-92H.

Horizon: A calcareous shale bed 1370 feet above the base of the Wapiabi formation, near the base of the Upper Concretionary member.

Locality: Mill Creek, section 4, unit 12, S. 12, T. 5, R. 2, W.5.

Remarks: Specimens are found on Thistle Creek which cluster together in beds or lenses and assume irregular shapes.

Superfamily ANOMIACEA

Genus ANOMIA Linnaeus, 1758

Anomia subquadrata Stanton

Anomia subquadrata Stanton, 1893, U.S. Geol. Surv. Bull. 106, p. 66, pl. 8, figs. 8, 9.

Description: From the external mold of a small specimen; hypotype, No. JW-59-7-92G.

The shell is small, has about the same length as height, is subcircular to subquadrate in outline, and deflated. Cardinal margin is slightly arched. The anterior and ventral margins merge in a continuous curve. The posteroventral margin is fairly sharply rounded. The beak is submarginal. Obscure concentric undulations mark the surface.

Measurements: The specimen is 13 mm. high and 13 mm. long.

Types: Hypotype, Research Council of Alberta No. JW-59-7-92G.

Horizon: From a calcareous shale bed 1370 feet above the base of the formation, in the Upper Concretionary member. This species occurs throughout the upper half of the Wapiabi formation.

Locality: Mill Creek, section 4, unit 12, S. 12, T. 5, R. 2, W.5.

Superfamily ANATINACEA

Genus PHOLADOMYA Hall 1869

Pholadomya sp., cf. P. occidentalis Morton

Plate 8, figure 3.

cf. Pholadomya occidentalis Morton. Wade, 1926, U.S. Geol. Surv., Prof. Paper 137, p. 72, pl. 23, figs. 13-15.

Description: From three deformed specimens in one bed of sandy shale; specimens, No's. JW-59-2-106A-C.

The shell is small for the species and longer than high; it is subovate in lateral outline, ventricose in the anterior region and has a straight hingeline. Anterior margin is subtruncate and curves into slightly convex, ventral margin. The beaks are near the anterior. The specimen is ornamented with quite strong, sharp radial ribs which are intersected by strong irregular concentric ridges.

Measurements: The shell is about 33 mm. long and 18 mm. high.

Types: Figured specimen, Research Council of Alberta No. JW-59-2-106A.

Horizon: A sandy shale bed 1312 feet above base of Wapiabi formation, in the Upper Concretionary member.

Locality: Oldfort Creek, section 3, unit 12, just below the main falls located about 1/3 of a mile above the old wooden highway bridge; T. 25, R. 8, W.5.

Remarks: The above described specimen is badly crushed but the ornament suggests that figured on Wade's specimen of P. occidentalis Morton.

Pholadomya sp.

Plate 7, figures 5, 6.

Description: From a cast of nearly a perfect specimen; No. JW-59-7-54B.

The shell is fairly large, subrectangular-subovate in outline

looking down on the valves and much longer than high. The beaks are very nearly anterior and both valves are identical. The specimen is well inflated; the umbonal slopes are steep to the anterior and very gentle to the posterior. The hingeline is long and the beaks are incurved. Both the dorsal and ventral margins are nearly straight; the anterior and posterior margins are rounded and the posterior margin semicircular. Minimum convexity occurs along the posterior margin. The ornament is made up of concentric growth lines; radial ribs extend from the beak as far back as the umbonal region.

Measurements: The specimen is 66 mm. long, 41 mm. high and has a convexity of 40 mm.

Types: Figured specimen, Research Council of Alberta No. JW-59-7-54B.

Horizon: It is from a shale bed 545 feet above the base of the Lower Concretionary member.

Locality: Mill Creek, section 4, unit 8, S. 12, T. 5, R. 2, W.5.

Remarks: The species is apparently undescribed for the western interior.

Superfamily ENDOSIPHONACEA

Genus LIOPISTHA Meek, 1864

Liopistha sp.

Plate 8, figure 1.

Description: From the cast of a deformed specimen; No. JW-59-2-134.

The shell is of moderate size for the genus, and longer than high; valves are evenly and slightly inflated; umbonal slopes are even. The beaks are situated very near the median. Anterior margin is well rounded into a broadly rounded ventor. The posterior end is obscurely

truncated. Radial ribs are present and are overrun by coarser, concentric ridges.

Measurements: The specimen is 26 mm. long and 20 mm. high. Convexity of this crushed specimen is at least 10 mm.

Types: Figured specimen, Research Council of Alberta No. JW-59-2-134.

Horizon: From sandy shale beds about 1560 feet above the base of the Wapiabi formation, in the Upper Concretionary Siltstone submember.

Locality: Oldfort Creek, section 3, unit 14, T. 25, R. 8, W.5.

Remarks: The specimen somewhat resembles Liopistha undata Meek and Hayden in shape and ornamentation as figured by Dowling (1917), and Warren (1931).

Superfamily LUCINACEA

Genus TANCREDIA Lycett, 1850

Tancredia americana Meek and Hayden

Plate 8, figure 2.

Tancredia americana Meek and Hayden. Meek, 1876, U.S. Geol. Surv. Terr., Vol. 9, p. 142, pl. 38, figs. 1a-h.

Tancredia americana Meek and Hayden. Dowling, 1917, Geol. Surv. Can., Mem. 93, pl. 27, figs. 6-6c, not described.

Description: From the external molds of two specimens; hypotypes, No's. JW-59-3-161A,B.

The shell is quite large for the species, longer than high, subovate and evenly inflated. Posterior and dorsal margins are convex and curve fairly sharply into a broadly rounded ventrum. The anterior margin is such that the beaks are situated near the median part of the shell. Dorso-anterior margin slopes gently away from the beaks; the anterior margin curves very sharply into the basal region. Umbonal slopes are gentle.

Measurements: The specimen is 62 mm. long and 30 mm. high.

Types: Hypotypes, Research Council of Alberta No's. UW-59-3-161A,B.

Horizon: A talus block of sandstone about 30 feet above the base of the Solomon sandstone.

Locality: Thistle Creek, section 1, unit 19, S. 16 and 17, T. 44, R. 20, W. 5.

Superfamily CARDIACEA

Genus CARDIUM Linnaeus, 1758

Cardium pauperculum Meek

Plate 7, figures 7, 8 and 9.

Cardium pauperculum Meek, 1871, Ann. Rept. U.S. Geol. Surv. Terr. for 1870, p. 306.

Cardium pauperculum Meek. Stanton, 1893, U.S. Geol. Surv. Bull. 106, p. 99, pl. 22, figs. 9-12.

Cardium pauperculum Meek. Nemethy, 1958, Alta. Soc. Pet. Geol., Eighth Ann. Field Conf., Nordegg, pl. 1, fig. 2, not described.

Cardium pauperculum Meek. Moore, 1959, M.Sc. Thesis, Univ. of Alta., p. 55, pl. 8, fig. 7.

Description: From one complete specimen; hypotype, JW-59-3-111A.

The shell is small, about as high as wide, obese, subcircular and has moderately prominent beaks which are nearly central. Each valve is ornamented with costae which give a crenated appearance to the margins. The postero-umbonal and anterior-umbonal slopes are steep and curve into slight concavity at the margins. The anterior and posterior margins slope and curve away from the beak about evenly and round off into a semicircular ventral margin. There are 1 or 2 growth lines on each valve which dissect the costae. Both valves are equal.

Measurements: The specimen is 8 mm. high, 7.7 mm. long and 6.3 mm. wide.

Types: Hypotypes, Research Council of Alberta No. JW-59-3-111A, B.

Horizon: A sandstone lens, near the top of the Lower Concretionary member and 825 feet above the base of the Wapiabi formation. Other specimens from upper beds of the Cardium formation on Oldfort Creek.

Locality: Thistle Creek, section 1, unit 8, S. 16 and 17, T. 44, R. 20, W.5.

Class GASTROPODA

Superorder PROSOBRANCHIA

Genus GLAUCONIA Giebel, 1852.

Glauconia sp.

Plate 4, figure 5.

Description: From one broken specimen; No. JW-59-3-43.

The shell is small, conical with impressed suture and convex volutions. A fairly strong rib is present on either side of the apex

of convexity on the last whorl, and there are numerous growth lines over the surface. The umbilicus is quite large and deep. The aperture is subovate in outline.

Measurements: The diameter of the last volution is about 10 mm.

Types: Figured specimen, Research Council of Alberta, No. JW-59-3-43.

Horizon: A concretion about 35 feet above the base of the Lower Concretionary Shale.

Locality: Thistle Creek, section 1, unit 5, S. 16 and 17, T. 44, R. 20, W.5.

Remarks: The specimen is smaller than Glauconia coalvillensis Meek and not as elongate, but does resemble the latter somewhat as figured by Stanton (1893).

Class CEPHALOPODA

Subclass AMMONOIDEA

Genus BACULITES Lamarck, 1799

Baculites ovatus Say

Plate 7, figure 3.

Baculites ovatus Say, 1820, Am. Jour. Sci., Ser. 1, Vol. 2, p. 41.

Baculites ovatus Say. Reeside, 1927, U.S. Geol. Surv., Prof. Paper 151, p. 9, pl. 5, figs. 12, 13; pl. 6, figs. 1-4; pl. 7, figs. 1-8. Contains further synonomy.

Baculites ovatus Say. Elias, 1933, Bull. Univ. Kan., Vol. 34, p. 297, 298, pl. 33, figs. 39a-c.

Baculites ovatus Say. Russell and Landes, 1940, Geol. Surv. Can., Mem. 221, p. 171.

Description: From a nearly complete living chamber; hypotype, No. JW-59-7-54D.

This large stout form is oval in cross-section and tapers gradually to the back. Nearly all of the living chamber is present. The siphonal side is indicated by a series of longitudinal furrows running along the venter. Sculpture consists of undulations in the latero-siphonal region which slant sharply back. Just on the dorsal side of the flanks the undulations swing forward. The sculpture curves across the ventrum and dorsum. Growth lines parallel the undulations. Only sections of the last suture are present. The saddles are much wider than the lobes.

Measurements: The dimensions of the extremities of the living chamber are 34 mm. by 25 mm. and 26 mm. by 20 mm. The living chamber is about 170 mm. long.

Types: Hypotype, Research Council of Alberta No. JW-59-7-54D.

Horizon: A shale bed about 545 feet up from the base of the Lower Concretionary member.

Locality: Mill Creek, section 4, unit S, S. 12, T. 5, R. 2, W.5.

Remarks: The ornament and suture resemble this species. The gradual tapering of the shell towards the back is also typical.

Baculites sp., cf. *B. ovatus* Say.

Plate 7, figures 4, 10.

cf. *Baculites ovatus* Say. Reeside, 1927, U.S. Geol. Surv. Prof. Paper, p. 9, pl. 5, figs. 12, 13; pl. 6, figs. 1-4; pl. 7, figs. 1-8.

Description: From a cast of a fragment of the septate portion; specimen, No. JW-59-3-130B.

The shell is oval in cross-section, and suture is very prominent, simple and consists of six saddles and six lobes. No saddle or lobe is deeply dissected but there are depressions in the troughs and crests which add symmetry. The saddles are wider than the lobes.

Measurements: No measurements are available from the cast.

Types: Figured specimen, Research Council of Alberta No. JW-59-3-130B.

Horizon: From the first limestone band in the Platy Shale member. This is about 1208 feet above the base of the Wapiabi formation.

Locality: Thistle Creek, section 1, base of unit 10, S. 16 and 17, T. 44, R. 20, W.5.

Remarks: The specimen is smaller than Baculites ovatus Say, but the suture resembles that figured by Reeside (1927).

Baculites sp., cf. B. codyensis Reeside

Plate 8, figure 5.

cf. Baculites codyensis Reeside, 1928, U.S. Geol. Surv., Prof. Paper 150, p. 4, pl. 2, figs. 6-19.

Description: From one small fragment of the living chamber; specimen, No. JW-59-3-145.

The shell is fairly slender, and the transverse section is elliptical. Ribs are small over the siphonal side and curve sharply backward along the flanks where they develop large arcuate nodes. Sculpture disappears before reaching the antisphonal side. The siphonal side is more sharply rounded than the antisiphonal side.

Measurements: The two diameters of this specimen are about 16 mm. and 11 mm.

Types: Figured specimen, Research Council of Alberta No. JW-59-3-145.

Horizon: A shale bed 1215 feet above base of Wapiabi formation, in the middle of the Platy Shale member.

Locality: Thistle Creek, section 1, unit 10, S. 16 and 17, T. 44, R. 20, W.5.

Remarks: This small, slender fragment resembles B. codyensis Reeside in its sculpture and transverse section.

Genus SCAPHITES Parkinson, 1811.

Scaphites preventricosus var. sweetgrassensis Cobban

Plate 3, figures 1-3.

Scaphites preventricosus var. sweetgrassensis Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 27, pl. 10, figs. 18-25.

Description: One complete specimen was collected; hypotype, No. JW-59-2A-4.

The specimen is fairly small, slender, oval in outline and has an extended living chamber. There are 23 primary and 76 secondary ribs on the exposed whorl with 13 primaries and 41 secondaries on the living chamber. The venter is quite broadly rounded over the living chamber, and the flanks are steep. The sculpture slants forward from the umbilical wall on the living chamber. The ribs are more closely spaced over the exposed septate coil than on the living chamber.

The first lateral saddle is dissected and is wider than the first lateral lobe. First lateral lobe is bifid and is not complex.

Measurements: The specimen is 55 mm. long, 41 mm. high and 20 mm. wide.

Types: Hypotype, Research Council of Alberta No. JW-59-2-A.

Horizon: Within 100 feet of the base of the Lower Concretionary member, from the talus.

Locality: Oldfort Creek, section 3, unit 1, T. 25, R. 8, W.5.

Remarks: This variety is distinguished from S. preventricosus Cobban by its smaller size, more slender form and more extended living chamber.

Scaphites ventricosus Meek and Hayden

Plate 4, figures 1, 2, 8.

Scaphites ventricosus Meek and Hayden, 1862, Proc. Acad. Nat. Sci. Phila., Vol. 14, p. 22.

Scaphites ventricosus Meek and Hayden. Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 31, pl. 12, figs. 1-10; pl. 13, figs. 11-13. Contains complete synonomy.

Scaphites ventricosus Meek and Hayden. Nemethy, 1958, Alta. Soc. Pet. Geol., Eighth Ann. Field Conf., Nordegg, pl. 1, fig. 2, not described.

Description: From a cast of a complete shell ; hypotype, No. JW-59-7-24A.

In side view this specimen is subcircular in outline, and the umbilical wall is straight on the last half of the living chamber. The aperture makes an angle of about 90 degrees with the straight part of the umbilical wall. The living chamber is partly free from the septate coil. The venter is well rounded. The width of the last whorl is about the same over the entire living chamber except for a slight narrowing near the septate coil.

The sculpture is quite coarse and is straight across the venter. Ribs are evenly spaced all along the outer whorl. On the outer

whorl there are at least 21 primaries and 70 secondaries with at least 9 primaries and 44 secondaries on the living chamber. There is furcation at the ventrolateral margin; numerous intercalated secondary ribs are present.

Measurements: The figured specimen is 73 mm. long, 66 mm. high and 42 mm. wide.

Types: Hypotype, Research Council of Alberta No. JW-59-7-24A.

Horizon: A bed of shale 200 feet above the base of the Lower Concretionary member.

Locality: Mill Creek, section 4, unit 3, S. 12, T. 5, R. 2, W.5.

Remarks: Immature specimens of this species are distinguished by marked tapering of the last part of the living chamber (plate 4, figure 2).

Scaphites sp., cf. S. interjectus Reeside

Plate 5, figure 4.

cf. Scaphites interjectus Reeside. Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 32, pl. 14, figs. 17-21.

Description: From a poorly preserved specimen showing suture; No. JW-59-RR-3.

The specimen is small, has a large umbilicus, a curved umbilical wall on the living chamber and a rounded venter.

The sculpture is strong but only a few secondary ribs can be seen. There are 10 primaries on the septate coil of the outer whorl. These are broad, rounded and widely spaced on the last part of the living chamber. Secondaries are evenly spaced over the venter. The suture is well defined and complex. The first lateral lobe is

symmetrically bifid and is dissected by a high saddle. The second lateral lobe is about as high as wide, and is symmetrically bifid or trifid. The second lateral saddle is bifid.

Measurements: The specimen is about 57 mm. long and 47 mm. high.

Types: Figured specimen, Research Council of Alberta No. JW-59-RR-3.

Horizon: A shale and ironstone concretion bed from the middle third of the Lower Concretionary member.

Locality: Ram River, T. 36, R. 14, W.5, near Falls Cabin, and just upstream from the Forestry bridge over the Ram River.

Remarks: Only one side of this specimen is preserved but the suture and spacing of primary ribs are indicative of Scaphites interjectus.

Scaphites depressus Reeside

Plate 5, figures 5 and 6.

Scaphites ventricosus var. depressus Reeside, 1927, U.S. Geol. Surv., Prof. Paper 150-A, p. 7, pl. 5, figs. 6-10.

Scaphites depressus Reeside. Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 32, pl. 15, figs. 6-8.

Description: From a cast of a large specimen; hypotype, No. JW-59-RR-10.

A very large, stout form with fairly large umbilicus, curved umbilical wall on the older part of living chamber and a well rounded venter. The living chamber tapers slightly towards the aperture which is wider than high.

The sculpture is well defined and evenly spaced with the secondaries close together over the aperture and the exposed septate coil. There are 22 primaries and about 86 secondaries on the outer

whorl and 13 primaries and 53 secondaries on the living chamber. Primaries are broadest at the ventrolateral margin.

The suture is complex and has an asymmetrically bifid first lateral lobe; the dorsal branch is more complex.

Measurements: The figured specimen is 112 mm. long, 86 mm. high and 63 mm. wide.

Types: Hypotype, Research Council of Alberta No. JM-59-RR-10.

Horizon: From the middle third of the Lower Concretionary member, in a bed of shale and ironstone concretions.

Locality: Ram River, T. 36, R. 14, W.5, near Falls Cabin.

Remarks: The maximum length which Cobban recorded for the species is 94 mm.

Scaphites depressus var. stantoni Reeside

Plate 5, figures 1, 2 and 3.

Scaphites ventricosus Meek and Hayden. Stanton, 1893, U.S. Geol. Surv., Bull. 106, p. 186, pl. 44, fig. 10 (non pl. 44, figs. 8,9; pl. 45, fig. 11).

Scaphites ventricosus Meek and Hayden. Logan, 1898, Kan. Univ. Geol. Surv., Vol. 4, p. 476, pl. 104, fig. 10 (non pl. 104, figs. 8, 9; pl. 105, fig. 1).

Scaphites ventricosus Meek and Hayden var. stantoni Reeside, 1927, U.S. Geol. Surv., Prof. Paper 150-A, p. 7, pl. 3, figs. 19, 20; pl. 4, figs. 5-10.

Scaphites depressus Reeside var. stantoni Reeside. Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 33, pl. 15, figs. 1-5.

Description: From a partly deformed specimen, with inner whorls preserved; hypotype, No. JW-59-RR-8.

The specimen is stout and has a well rounded venter, a fairly large umbilicus, and is quite large. The septate coil is partially separated from the living chamber. The umbilical wall on the living chamber is slightly curved.

The sculpture is well defined and is evenly spaced over the venter. The primaries split at least into two at the ventrolateral margin. There are 23 primaries on the outer whorl and 16 on the living chamber. There are 76 secondaries on the outer whorl and 55 on the living chamber. The ratio of primaries to secondaries decreases towards the rear of the living chamber.

The suture is complex; the first lateral lobe is symmetrically bifid and first lateral saddle is greatly dissected.

Measurements: The fossil is 71 mm. long, about 63 mm. high and 42 mm. wide.

Types: Hypotype, Research Council of Alberta No. JW-59-RR-8.

Horizon: From the middle third of the Lower Concretionary member.

Locality: Ram River, T. 36, R. 14, W.5, near Falls Cabin.

Remarks: This stout variety is distinguished from S. depressus Reeside by its smaller size, and by having the living chamber slightly separated from the septate coil.

Genus CLIOSCAPHITES Cobban, 1951

Clioscaphites montanensis Cobban

Plate 6, figures 5 and 6.

Clioscaphites montanensis Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 34, pl. 17, figs. 1-3; pl. 20, figs. 10-14.

Description: From a specimen lacking septate coil on outer whorl; hypotype, No. JW-59-7-72A.

The specimen is large, stout, tightly coiled, has a well rounded venter and broadly rounded flanks, which extend over the umbilicus. The umbilical wall is straight. There is a slight narrowing over the last part of the living chamber.

The ribs are concentrated and evenly spaced over the front part of the living chamber and the last part of the septate coil. Over the last part of the living chamber ribs are spaced further apart. There are 12 primaries and 57 secondaries on the living chamber. The primaries are broad and rounded and split into two or three at the ventrolateral margin. Secondaries curve forward over the last part of the living chamber. The suture is complex.

Measurements: The specimen is 95 mm. long, about 80 mm. high and 57 mm. wide.

Types: Hypotype, Research Council of Alberta, No. JW-59-7-72A.

Horizon: From the lower part of the Platy Shale member, 85 feet above the base.

Locality: Mill Creek, section 4, unit 9, S. 12, T. 5, R. 2, W.5

Clioscaphites montanensis Cobban var.

Plate 6, figure 3.

Description: From one specimen without part of the septate coil on the outer whorl; holotype, No. JW-59-4-41B.

The specimen is large, nearly circular in side view, has

flattened flanks, small umbilicus, rounded venter and evenly spaced ribs on the outer whorl. The septate coil is entirely in contact with the dorsum. The flanks are extended over the umbilicus giving a straight margin on the older half of the living chamber. A dorsal lappet is present on the aperture. The aperture is rounded in outline.

There are about 16 primaries and 71 secondaries on the living chamber and possibly 25 primaries and 86 secondaries on the complete outer whorl. The ribs go straight across the venter, and the primaries attain greatest height at the margin of the venter where they split into two or three.

Measurements: It is 81 mm. long, 76 mm. high and 40 mm. wide.

Types: Holotype, Research Council of Alberta, No. JW-59-4-41B.

Horizon: From the upper part of the Lower Concretionary member, in talus about 480 feet above the base.

Locality: Cardinal River section 2, unit 6, S. 13, T. 45, R. 20, W.5.

Remarks: A new variety is suggested mainly because of the distinctly flattened flanks which extend far into the coiled portion.

Clioscaphites vermiformis (Meek and Hayden)

Plate 6, figures 1, 2.

Scaphites vermiformis Meek and Hayden, 1862, Trans. Acad. Nat. Sci. Phila., Vol. 14, p. 22.

Clioscaphites vermiformis (Meek and Hayden). Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 35, pl. 18, figs. 7-27. Contains complete synonomy.

Description: From one complete specimen; hypotype, No. JW-59-4-41A.

This specimen is stout and tightly coiled. The whorl section is broader than high. The venter is flattened at the beginning of the last whorl and is broadly rounded over the living chamber. The umbilicus is narrow. The living chamber is curved; it is attached to the septate coil and its flanks are inclined inward. The aperture is subcircular in outline. The specimen is subcircular in side view.

There are 22 primaries and 76 secondaries on the exposed whorl with 10 primaries and 36 secondaries occurring on the living chamber. Sharp nodes are strongest over the middle third of the living chamber and extend back two primaries beyond the living chamber. Nodes become progressively smaller to the aperture. The primary ribs are coarse over the living chamber but are small over the septate coil on the first whorl. The ribs go straight across the venter. There are three secondaries to every primary over the middle of the living chamber.

The suture is complex and first lateral lobe is bifid. The first lateral saddle is asymmetrically bifid.

Measurements: The specimen is 67 mm. long, 56 mm. high and 39 mm. wide.

Types: Hypotype, Research Council of Alberta No. JW-59-4-41A.

Horizon: In a side gully about 480 feet above the base of Lower Concretionary member.

Locality: Cardinal River, section 2, unit 6, S. 13, T. 45, R. 20, W. 5.

Clioscaphites vermiformis var. toolensis Cobban

Plate 6, figure 4.

Clioscaphites vermiformis (Meek and Hayden) var. toolensis Cobban, 1951, U.S. Geol. Surv., Prof. Paper 239, p. 36, pl. 19, figs. 1-10.

Description: From one distorted specimen consisting of most of the outer whorl; hypotype, No. JW-59-4-41C.

The specimen is large, has a broadly rounded venter, depressed whorl, tightly coiled form, and a small umbilicus. Nodes are well developed from the last part of the septate coil over three-quarters of the living chamber. The nodes decrease markedly in size towards the aperture.

There are about 12 primaries and at least 45 secondaries on the living chamber. Secondary ribs are closely spaced and quite sharp over the front part of the living chamber. These ribs become rounded as the nodes increase in size; the secondaries are straight over the venter. The suture is quite complex.

Measurements: The specimen is about 80 mm. long.

Types: Hypotype, Research Council of Alberta, No. JW-59-4-41C.

Horizon: In the same side gully as Clioscaphites vermiformis (Meek and Hayden) above.

Locality: Cardinal River, section 4, unit 6, S. 13, T. 45, R. 20, W.5.

Genus DESMOSCAPHITES Reeside, 1927

Desmoscaphites sp?

Plate 8, figure 6.

Description: From 4 young specimens and one adult in the same concre-

tion. The following description based on the adult; No. JW-59-5-4I.

This is a fairly large specimen which has a broadly rounded venter and evenly curved umbilical wall on the living chamber. The living chamber is not freed from the septate coil and tapers slightly towards the aperture. The form is 70 mm. long, 65 mm. high and 35 mm. wide.

The secondary ribs are very fine closely spaced, and arch forward in the apertural region. Primary ribs are very coarse and crested and form nodes at the ventrolateral margin. There are four or five secondaries to every primary over central part of the living chamber. Certain intercalated secondaries extend far down the flanks over the central part of living chamber.

Measurements: The specimen is 70 mm. long and 65 mm. high.

Types: Figured specimen, Research Council of Alberta, No. JW-59-5-4G.

Horizon and Locality: It was collected from a concretion in a road outcrop 8 miles north of Burmis, S. 11, T. 9, R. 2, W.5. This is near the upper part of the Platy Shale member.

Remarks: The specimen resembles Clioscaphites? choteauensis Cobban, but on the basis of immature specimens collected in the same concretion, it is designated as Desmoscaphites sp.? Ribs on immature forms curve forward over the venter and pairs join at the ventrolateral margin to form primaries from a diameter of 8 to 10 mm.

Genus PLACENTICERAS Meek, 1870

Placenticeras sp.

Description: From part of the living chamber; specimen, No. JW-59-5-4H.

The specimen is poorly preserved and is very large. There are high ribs on the flanks of the living chamber which end in pronounced nodes. The venter is flat.

Measurements: None available.

Types: Described specimen, Research Council of Alberta, No. JW-59-5-4H.

Horizon and Locality: It is from a concretion near the top of the Platy Shale member, in a road outcrop 8 miles north of Burmis, S. 13, T. 9, R. 2, W.5.

Remarks: Since the specimen is only a fragment of the living chamber it cannot be assigned to any particular species.

EXPLANATION OF PLATE 3

Inoceramus deformis-Scaphites preventricosus zone

From the upper beds of the Cardium formation to 150 feet above the base of the Lower Concretionary member of the Wapiabi formation.

Figs. 1, 2, 3: Scaphites preventricosus var. sweetgrassensis Cobban; side, front and second from last suture; hypotype, Research Council of Alberta No. JW-59-2A-4. (p. 49).

Figs. 4, 5: Inoceramus sp., cf. I. pontoni McLearn; anterior and top view of a right valve; figured specimen, Research Council of Alberta No. JW-59-2-11D. (p. 35).

Fig. 6: Inoceramus undabundus Meek and Hayden; left valve showing prominent beak and concentric undulations; hypotype, Research Council of Alberta No. JW-59-2-2a. (p. 30).

Figs. 7, 8: Inoceramus deformis Meek; right valves of young and mature specimens showing development of ornamentation; hypotypes, Research Council of Alberta Nos. JW-59-7-18a & b. (p. 28).

PLATE 3

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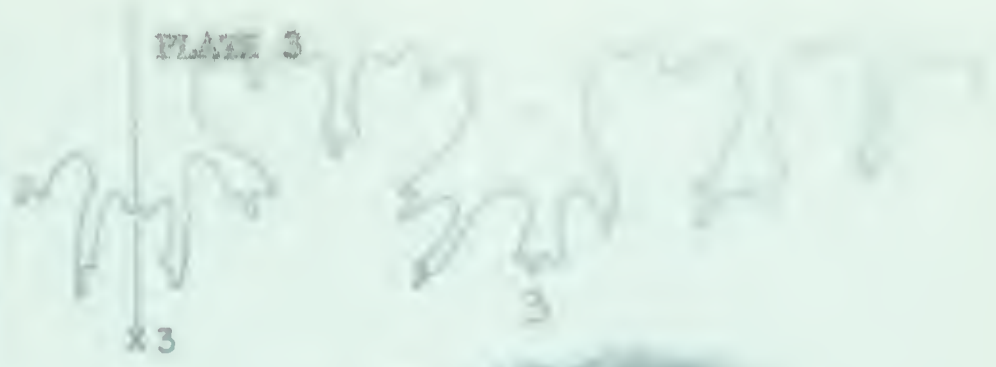

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PLATE 3

EXPLANATION OF PLATE 3

Inoceramus deformis-Scaphites preventricosus zone

From the upper beds of the Cardium Formation to 150 feet above the base of the Lower Concretionary member of the Bapiabi Formation.

Figs. 1, 2, 3: Scaphites preventricosus var. ventricosiformis Cobban; side, front and ventral views of latex cast; hypotype, Research Council of Alberta No. RC-59-3A-4. (p. 49).

Figs. 4, 5: Inoceramus sp. A, cf. I. pontoni McLearn; anterior and top view of a right valve; figured specimen, Research Council of Alberta No. RC-59-3-11b. (p. 35).

Fig. 6: Inoceramus anabasanus Meek and Hayden; left valve showing prominent keel and concentric undulations; hypotype, Research Council of Alberta No. RC-59-2-2a. (p. 30).

Figs. 7, 8: Inoceramus deformis Meek; right valves of young and mature specimens showing development of undulations; hypotypes, Research Council of Alberta Reg. RC-59-7-15a & b. (p. 28).

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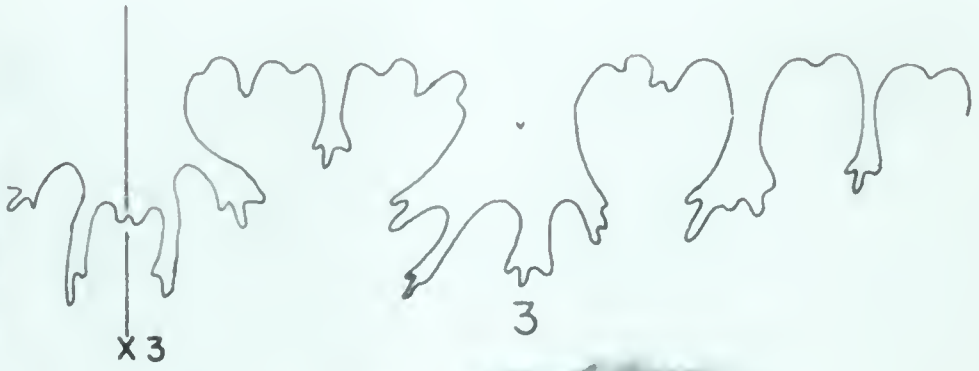

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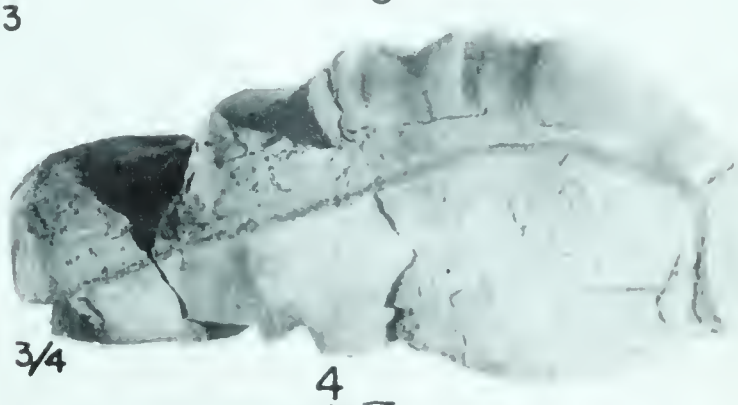

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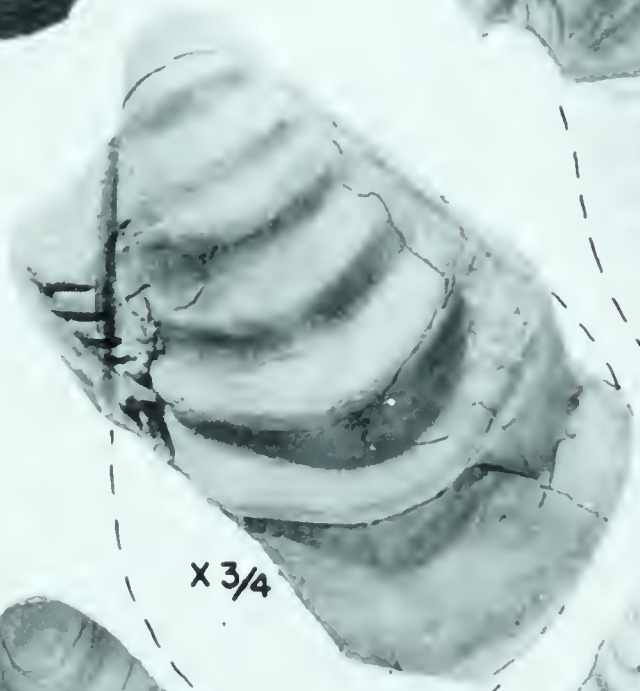

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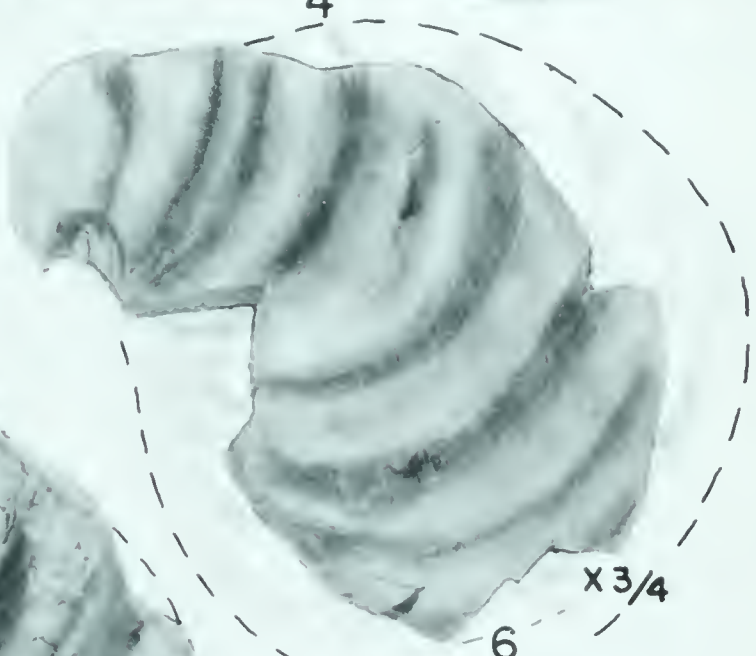

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EXPLANATION OF PLATE 4

Inoceramus involutus-Scaphites ventricosus zone

From 150 to at least 300 feet above the base of the Lower Concretionary member of the Wapiabi formation.

Figs. 1, 2, 8: Scaphites ventricosus Meek and Hayden. 1, 8 - side views of adult forms; 1 - hypotype, Research Council of Alberta No. JW-59-7-24A; 8 - hypotype, Research Council of Alberta No. JW-59-2-47; 2 - living chamber of immature specimen; hypotype, Research Council of Alberta No. JW-49-2-57. (p. 50).

Figs. 3, 4: Inoceramus exogyroides Meek and Hayden; anterior and side views of a left valve showing incurved beak and prominent umbonal region; hypotype, Research Council of Alberta No. JW-59-3-43. (p. 31).

Fig. 5: Glauconia sp.; dorsal view; figured specimen, Research Council of Alberta No. JW-59-3-43. (p. 45).

Fig. 6: Inoceramus sp., cf. I. deformis Meek; side view of left valve; figured specimen, Research Council of Alberta No. JW-59-2-11c. (p. 29).

Fig. 7: Inoceramus sp., aff. I. undabundus Meek and Hayden. View of a large specimen consisting of beak and dorsal regions; figured specimen, Research Council of Alberta No. JW-59-2-32B. (p. 31).

Fig. 9: Inoceramus sp., cf. I. selwyni McLearn; view of the latero-umbonal area of a large right valve; figured specimen, Research Council of Alberta No. JW-59-2-32A. (p.36).

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EXPLANATION OF PLATE 4

Inoceramus labiatus-Scaphites ventricosus zone

From 150 to at least 300 feet above the base of the Lower Concretionary member of the Wapiabi Formation.

Figs. 1, 2, 8. Scaphites ventricosus Meek and Hayden. 1, 8 - side view of adult forms; 1 - hypotype, Research Council of Alberta No. JW-59-7-244; 8 - hypotype, Research Council of Alberta No. JW-59-2-67; 2 - living chamber of immature specimen; hypotype, Research Council of Alberta No. JW-49-2-67. (p. 50).

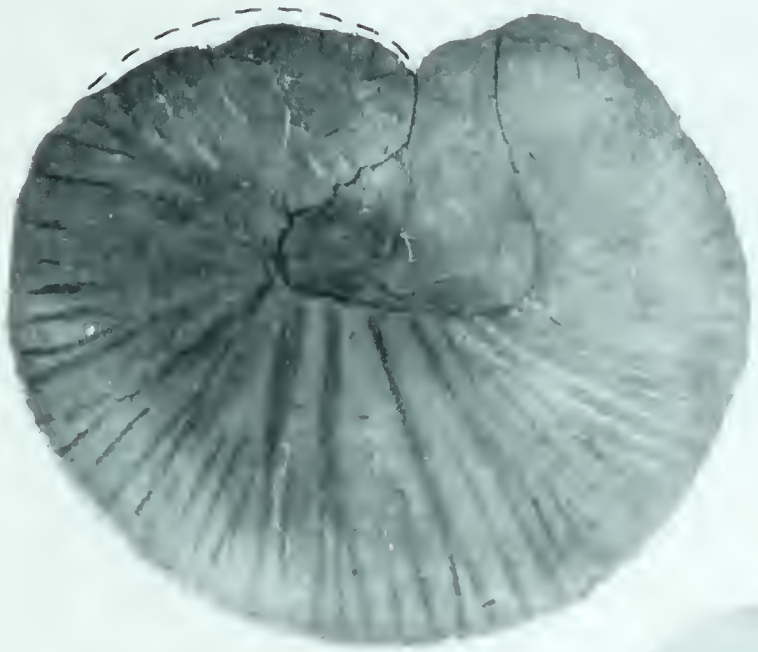
Figs. 3, 4. Inoceramus crogroiden Meek and Hayden; anterior and side views of a left valve showing incurved beak and prominent umbonal region; hypotype, Research Council of Alberta No. JW-59-3-43. (p. 31).

Fig. 5: Cimomia sp.; dorsal view; figured specimen, Research Council of Alberta No. JW-59-3-43. (p. 45).

Fig. 6: Inoceramus sp., cf. I. deformis Meek; side view of left valve; figured specimen, Research Council of Alberta No. JW-59-2-11c. (p. 29).

Fig. 7: Inoceramus sp., aff. I. undabundus Meek and Hayden. View of a large specimen consisting of beak and dorsal regions; figured specimen, Research Council of Alberta No. JW-59-2-32B. (p. 31).

Fig. 9: Inoceramus sp., cf. I. selwyni McLearn; view of the latero-umbonal area of a large right valve; figured specimen, Research Council of Alberta No. JW-59-2-32A. (p. 31).



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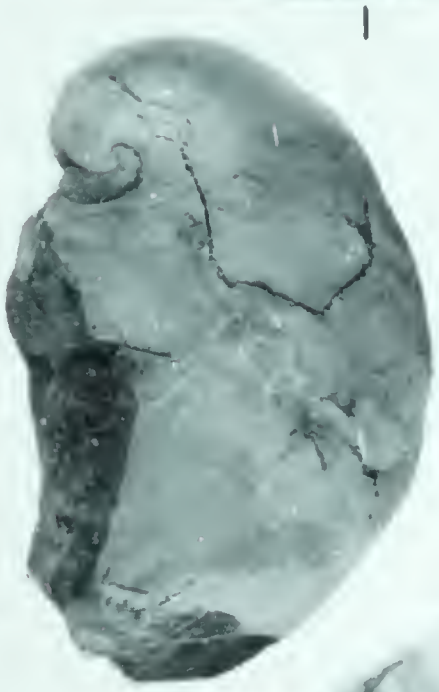

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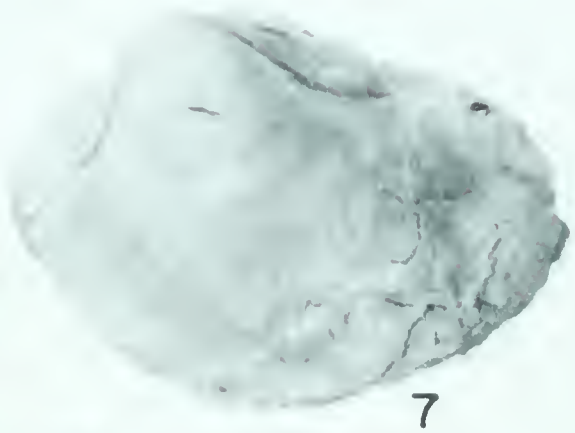

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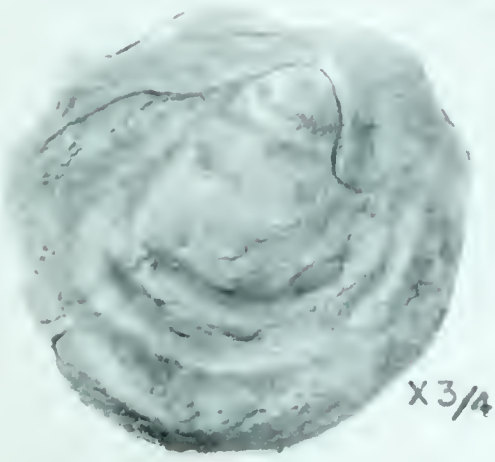

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EXPLANATION OF PLATE 5

Scaphites depressus zone

From the middle third of the Lower Concretionary member, between 300 and 350 feet above the base of the Wapiabi formation.

Figs. 1, 2, 3: Scaphites depressus var. stantoni Reeside; side view, internal mold and suture from internal mold; hypotype, Research Council of Alberta No. JW-59-R.R.-8. (p. 53).

Figs. 5, 6: Scaphites depressus Reeside; 5 - second from last suture of a large specimen; hypotype, Research Council of Alberta No. JW-59-R.R.-10; 6 - side view of a large specimen; Research Council of Alberta No. JW-59-3-90A. (p.52).

Fig. 4: Scaphites sp., cf. interjectus Reeside; composite of the second and third last sutures showing one half of the first lateral lobe plus the remaining suture towards the dorsal side; hypotype, Research Council of Alberta No. JW-59-R.R.-3. (p.51).

Figs. 7, 8: Inoceramus sp., cf. I. umbonatus Meek and Hayden; side and anterior views of a left valve; figured specimen, Research Council of Alberta No. JW-59-2-47B. (p.32).

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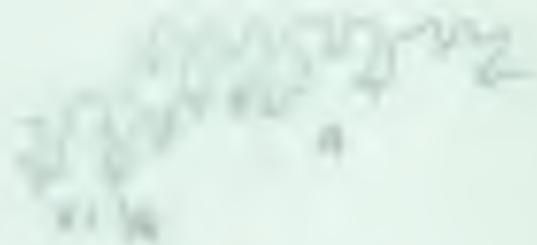

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PLATE 4

EXPLANATION OF PLATE 4

Scambites dentosus zone

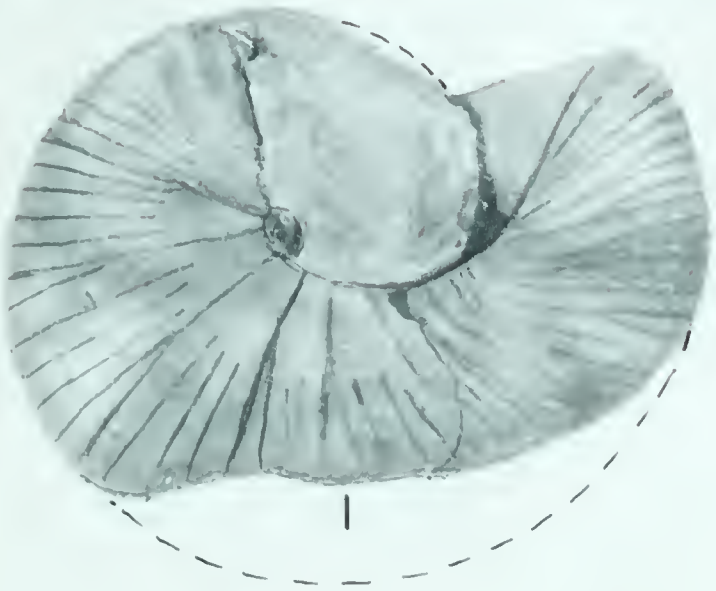
From the middle third of the Lower Conrectionary member, between 300 and 350 feet above the base of the Wapiabi Formation.

Figs. 1, 2, 3: Scambites dentosus var. stantoni Reeside; side view, internal mold and suture from internal mold; hypotype, Research Council of Alberta No. JW-59-S.S.-5. (p. 53).

Figs. 4, 5: Scambites dentosus Reeside; 5 - second from last suture of a large specimen; hypotype, Research Council of Alberta No. JW-59-S.S.-10; 6 - side view of a large specimen; Research Council of Alberta No. JW-59-S-9UA. (p.52).

Fig. 6: Scambites sp., cf. interjectus Reeside; composite of the second and third last sutures showing one half of the first lateral lobe plus the remaining suture towards the dorsal side; hypotype, Research Council of Alberta No. JW-59-S.S.-1. (p.51).

Figs. 7, 8: Inoceramus sp., cf. I. deformatus Meek and Hayden; side and posterior views of a left valve; figured specimen, Research Council of Alberta No. JW-59-2-479. (p.32).



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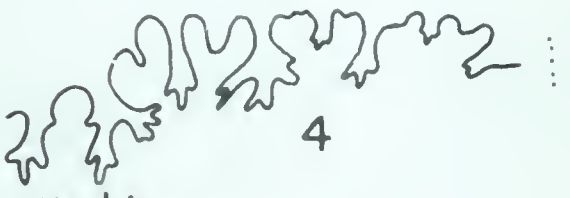

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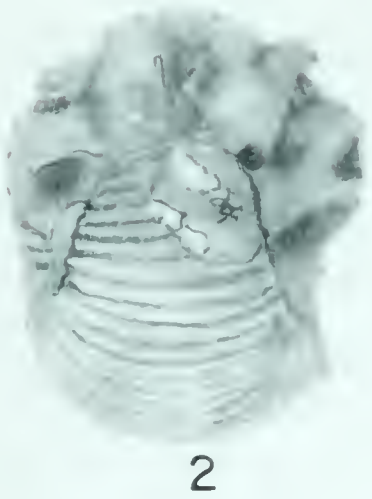

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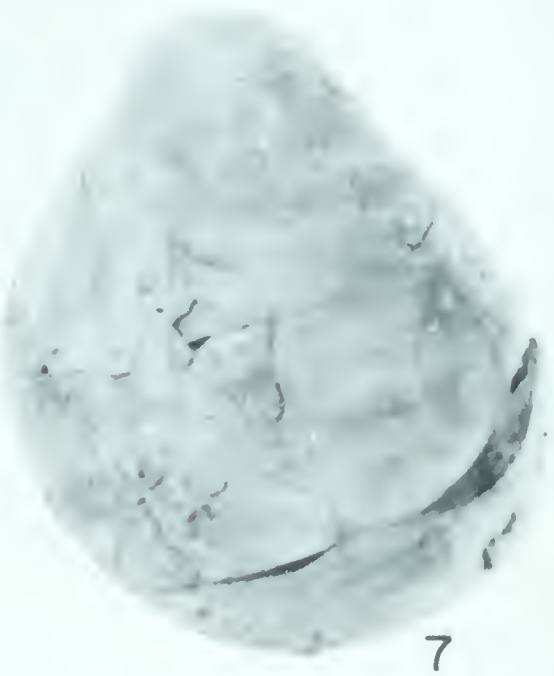

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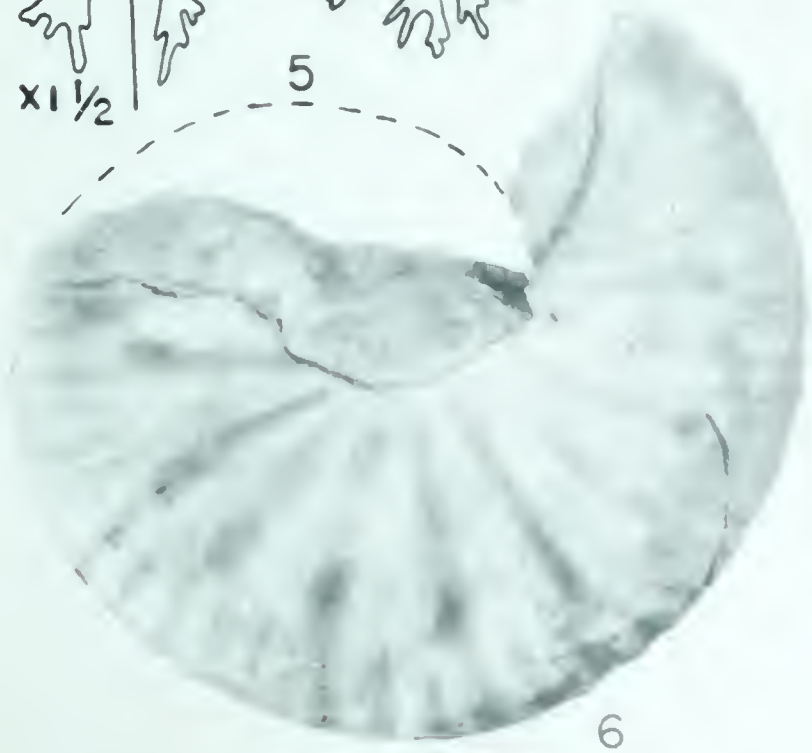

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EXPLANATION OF PLATE 6

Clioscaphites montanensis and

Inoceramus cordiformis zone

The upper 100 to 200 feet of the Lower Concretionary member and the lower third of the Platy Shale member.

Figs. 1, 2: *Clioscaphites vermiformis* (Meek and Hayden); side view and third from last suture of same specimen; hypotype, Research Council of Alberta No. JW-59-4-41A. (p. 56).

Fig. 3: *Clioscaphites montanensis* Cobban var.; side view of specimen showing flanks extending over umbilicus on the living chamber; holotype, Research Council of Alberta No. JW-59-4-41B. (p. 55).

Fig. 4: *Clioscaphites vermiformis* var. *toolensis* Cobban; side view of a deformed specimen showing tight coiling and prominent primary ribs ending in nodes at the ventro-lateral margin; hypotype, Research Council of Alberta No. JW-59-4-41C. (Same as figs. 1-3) on Cardinal River. (p. 58).

Figs. 5, 6: *Clioscaphites montanensis* Cobban; ventral view of last part of living chamber and side view of same specimen; hypotype, Research Council of Alberta No. JW-59-7-72A. (p. 54).

Fig. 7: *Inoceramus* sp., cf. *I. coulthardi* McLearn; side view of a left valve; figured specimen, Research Council of Alberta No. JW-59-4-41E. (p. 34).

PLATE 6

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PLATE 6

EXPLANATION OF PLATE 6

Cliosphinctes montanensis and

Inoceramus cordiformis zone

The upper 100 to 200 feet of the Lower Concretionary member and the lower third of the Flare Shale member.

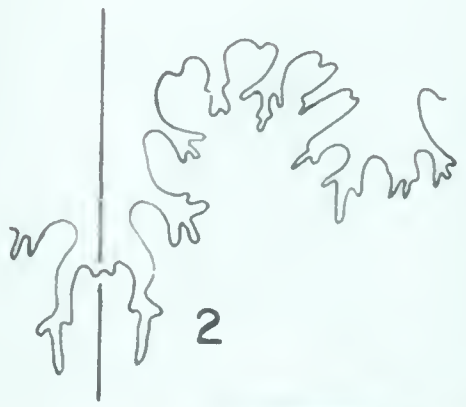
Figs. 1, 2: Cliosphinctes vermiformis (Stock and Hayden); side view and third from last suture of same specimen; hypotype, Research Council of Alberta No. JW-59-4-41A. (p. 56).

Fig. 3: Cliosphinctes montanensis Cobban var.; side view of specimen showing flanks extending over umbilicus on the living chamber; holotype, Research Council of Alberta No. JW-59-4-41B. (p. 55).

Fig. 4: Cliosphinctes vermiformis var. toolunsis Cobban; side view of a deformed specimen showing tight coiling and prominent primary ribs ending in nodes at the ventro-lateral margin; hypotype, Research Council of Alberta No. JW-59-4-41C. (Same as Figs. 1-3) on Cardinal River. (p. 50).

Figs. 5, 6: Cliosphinctes montanensis Cobban; ventral view of last part of living chamber and side view of same specimen; hypotype, Research Council of Alberta No. JW-59-7-73A. (p. 54).

Fig. 7: Inoceramus sp., cf. I. coulthardi McLearn; side view of a left valve; figured specimen, Research Council of Alberta No. JW-59-4-41E. (p. 34).



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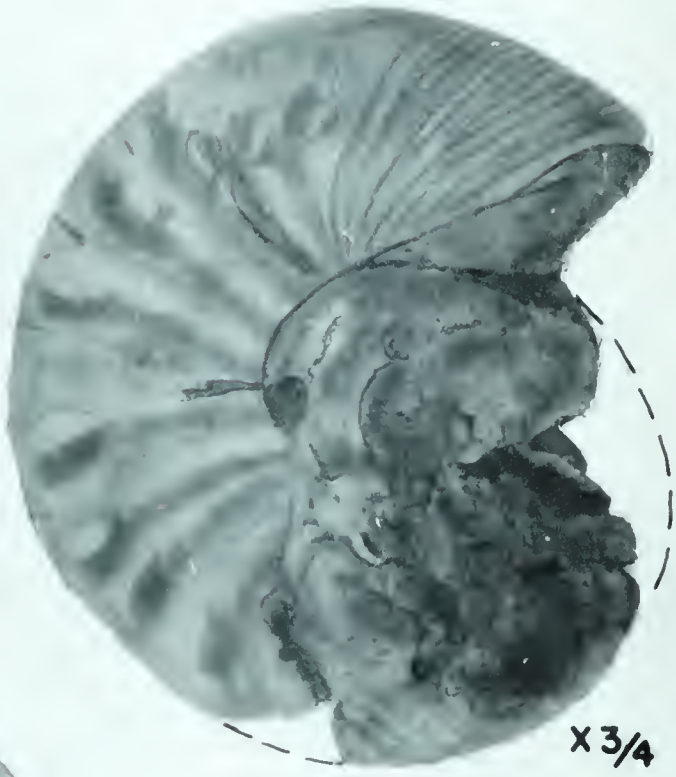

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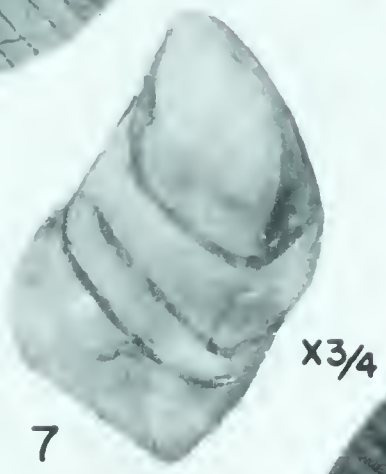

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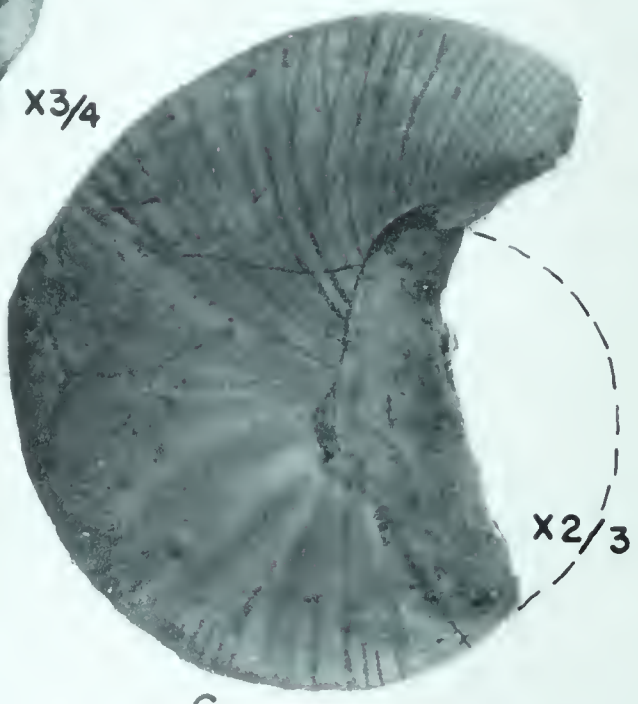

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EXPLANATION OF PLATE 7

Desmoscaphites zone

From about the middle of the Platy Shale member to the top of the Transition member.

Fig. 1: *Unintacrinus* sp.?; view of arm plates (x2); figured specimen, Research Council of Alberta No. JW-59-3-130G. (p. 27).

Fig. 2: *Inoceramus* sp., cf. *I. selwyni* McLearn; view of both valves of a small specimen; figured specimen, Research Council of Alberta No. JW-59-2-60B. (p. 33).

Fig. 3: *Baculites ovatus* Say; side view of living chamber and end view of a smaller specimen; hypotype, Research Council of Alberta No. JW-59-7-54D. (p. 46).

Figs. 4, 10: *Baculites* sp., cf. *B. ovatus* Say; side view of specimen showing suture; figured specimen, Research Council of Alberta No. JW-59-3-130B. (p. 47).

Figs. 5, 6: *Pholadomya* sp.; dorsal view and side view of left valve; figured specimen, Research Council of Alberta No. JW-59-7-54B. (p. 41).

Figs. 7, 8, 9: *Cardium pauperculum* Meek; 7, 9 - two left valves; 8 - anterior view of both valves; hypotypes, Research Council of Alberta No. JW-59-3-111A,B. (p. 44).

PLATE 7

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PLATE 7

EXPLANATION OF PLATE 7

Desmoscaphites zone

From about the middle of the Pierre Shale member to the top of the Transition member.

Fig. 1: Unintercalate sp.?; view of arm plates (x2); figured specimen, Research Council of Alberta No. JW-59-3-1106. (p. 27).

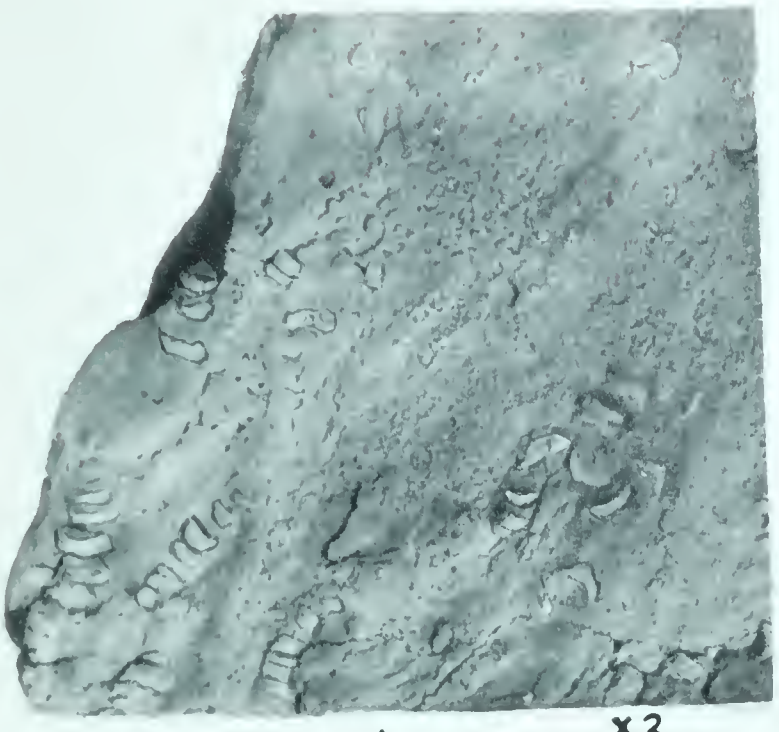
Fig. 2: Inoceramus sp., cf. I. selwyni McLearn; view of both valves of a small specimen; figured specimen, Research Council of Alberta No. JW-59-2-600. (p. 33).

Fig. 3: Baculites ovatus Say; side view of living chamber and end view of a smaller specimen; hypotype, Research Council of Alberta No. JW-59-7-549. (p. 46).

Figs. 4, 10: Baculites sp., cf. B. ovatus Say; side view of specimen showing suture; figured specimen, Research Council of Alberta No. JW-59-3-1308. (p. 47).

Figs. 5, 6: Rhadinops sp.; dorsal view and side view of left valve; figured specimen, Research Council of Alberta No. JW-59-7-548. (p. 41).

Figs. 7, 8, 9: Cardium pauperculum Meek; 7, 9 - two left valves; 8 - anterior view of both valves; hypotypes, Research Council of Alberta No. JW-59-3-1114,8. (p. 44).



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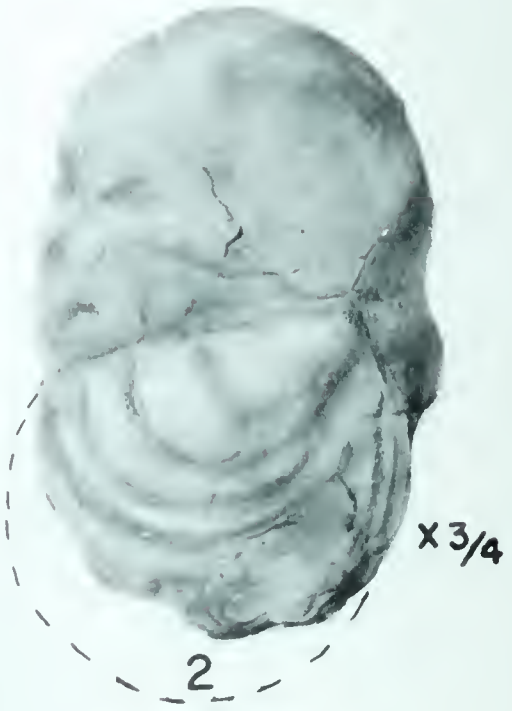

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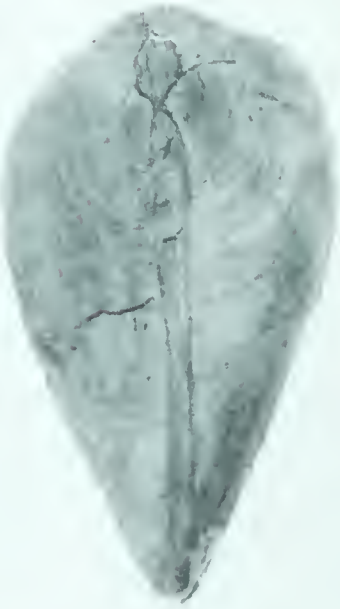

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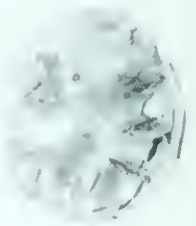

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EXPLANATION OF PLATE 8

Desmoscaphites zone

From about the middle of the Platy Shale member to the top of the Transition member.

Fig. 1: Liopistha sp.; view of right valve; figured specimen, Research Council of Alberta No. JW-59-2-134. (p. 42).

Fig. 2: Tancredia americana Meek and Hayden; view of two molds of left valves in a block of sandstone; hypotype, Research Council of Alberta No. JW-59-3-161A,B. (p. 43).

Fig. 3: Pholadomya sp., cf. P. occidentalis Morton; view of both valves of a crushed specimen as seen from the venter; figured specimen, Research Council of Alberta No. JW-59-2-106. (p. 40).

Fig. 4: Ostrea congesta Conrad; view of lower valve; hypotype, Research Council of Alberta No. JW-59-7-92H. (p. 39).

Fig. 5: Baculites sp., cf. B. codyensis Reeside; side view of a fragment of a small form; figured specimen, Research Council of Alberta No. JW-59-3-145. (p. 48).

Fig. 6: Desmoscaphites sp.?; side view of an immature specimen; figured specimen, Research Council of Alberta No. JW-59-5-4G. (p. 58).

Fig. 7: Inoceramus lundbreckensis McLearn; side view of a partial left valve; hypotype, Research Council of Alberta No. JW-59-3-130A. (p. 37).

Fig. 8: Pteria sp.; side view of right valve; figured specimen, Research Council of Alberta No. JW-59-7-94C. (p. 38).

Fig. 9: Inoceramus sp.; left valve of a fairly large specimen; figured specimen, Research Council of Alberta No. JW-59-5-4G. (p. 36).


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PLATE 9

EXPLANATION OF PLATE 9

Scaphites zone

From about the middle of the Plain Shale member to the top of the Transition member.

Fig. 1: Liopistha sp.; view of right valve; figured specimen, Research Council of Alberta No. JM-59-2-134. (p. 42).

Fig. 2: Tancredia americana Meek and Hayden; view of two molds of left valves in a block of sandstone; hypotype, Research Council of Alberta No. JM-59-3-161A,B. (p. 43).

Fig. 3: Rhytadonta sp., cf. R. occidentalis Morton; view of both valves of a crushed specimen as seen from the venter; figured specimen, Research Council of Alberta No. JM-59-2-106. (p. 40).

Fig. 4: Ostrea congesta Conrad; view of lower valve; hypotype, Research Council of Alberta No. JM-59-7-92B. (p. 39).

Fig. 5: Nuculana sp., cf. N. conradana Dowside; side view of a fragment of a small form; figured specimen, Research Council of Alberta No. JM-59-3-145. (p. 40).

Fig. 6: Yoldiscaplites sp.?; side view of an immature specimen; figured specimen, Research Council of Alberta No. JM-59-5-60. (p. 58).

Fig. 7: Inoceramus lundbreckensis McLearn; side view of a partial left valve; hypotype, Research Council of Alberta No. JM-59-3-130A. (p. 37).

Fig. 8: Pteria sp.; side view of right valve; figured specimen, Research Council of Alberta No. JM-59-7-94C. (p. 38).

Fig. 9: Inoceramus sp.; left valve of a fairly large specimen; figured specimen, Research Council of Alberta No. JM-59-5-40. (p. 36).

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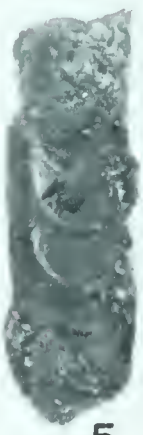

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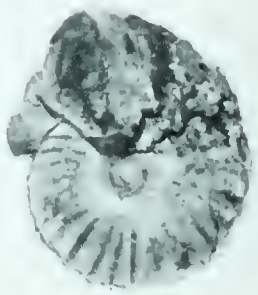

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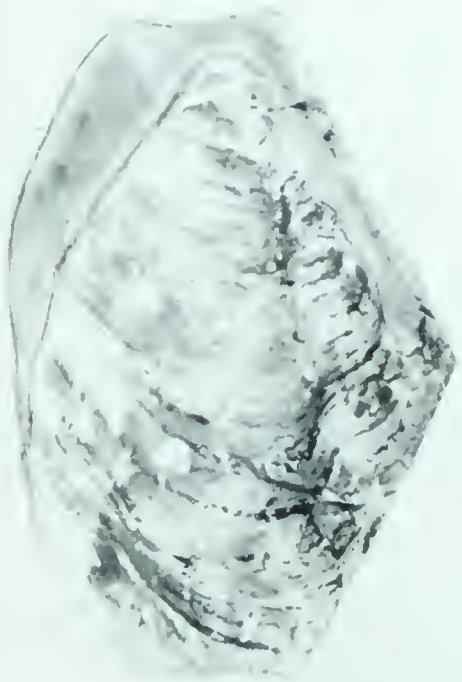

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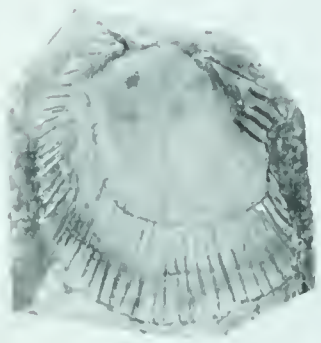

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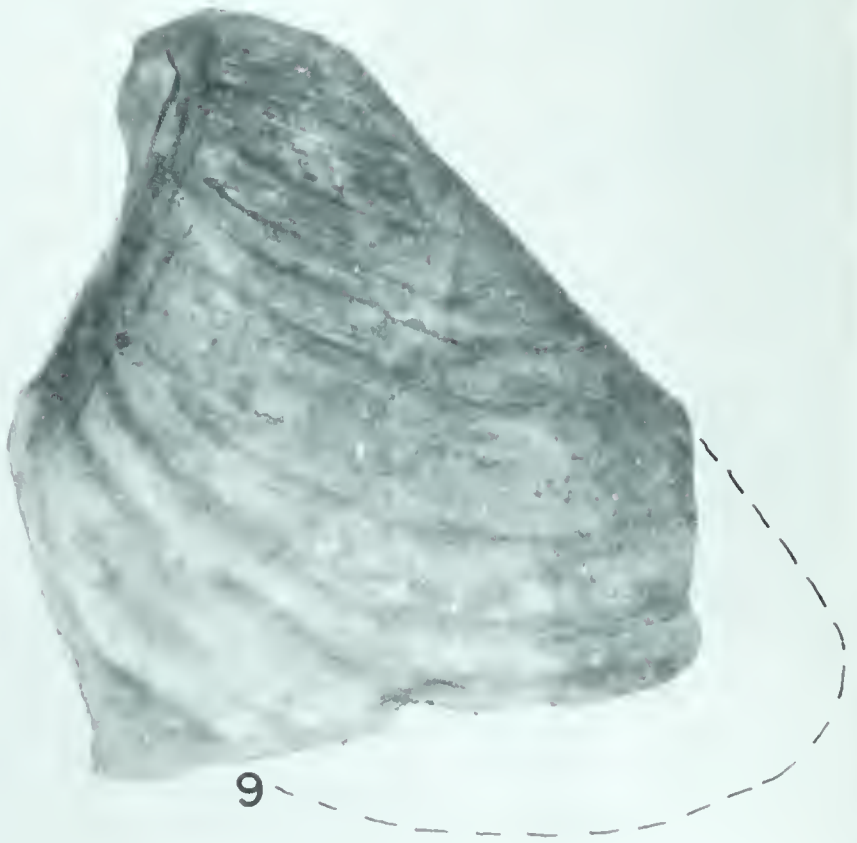

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APPENDIX

Section 1: Thistle Creek
S. 14 & 15, T. 44, R. 20, W. 5.
Wall and Germundson (1959)

A nearly complete section of the Wapiabi formation, 2515 feet thick, extends upstream from the Cardium-Wapiabi contact for slightly over a mile to the Brazeau formation. All members and sub-members are recognized, but some contacts are not well-defined. A large part of the Lower Concretionary Shale sub-member is talus covered, but was sampled by trenching.

Slight variations in the attitudes of the beds occur, but no folding or faulting was noted.

Representatives of the Inoceramus involutus-Scaphites ventricosus zone were collected from the top of the Striped sub-member and the middle part of the Lower Concretionary Siltstone sub-member. Fossils from the Clioscaphites montanensis-Inoceramus deformis zone were collected from the middle third of the Platy Shale member.

A vehicle may be used from Mountain Park to the junction of the Cardinal River and Ruby Creek (S. 11, T. 45, R. 21, W. 5). A good pack-trail leads south 6 miles to the section. The best camp-site is 3 miles north of the section at Flapjack Lake.

Unit	Thickness of unit	Feet above base	Description
			Basal Brazeau:
			Sandstone, light grey, platy to massive, medium to coarse-grained; calcareous; weathers buff with deep green stain.
			Wapiabi formation
Transition member	108'		
28	14'	2515'	Sandstone, olive green, fine-grained; dark grey shale lenses and partings.
27	9'	2501'	Sandstone and siltstone, medium grey to olive green, blocky; interbedded with shale at base; shale partings at top.

Unit	Thickness of unit	Feet above base	Description
26	14'	2492'	Sandstone, light grey to olive green, very fine-grained; shale partings and lenses; slightly calcareous.
25	49'	2478'	Shale, medium-dark grey, silty-sandy; siltstone bands throughout; glauconitic locally, carbonaceous.
24	22'	2429'	Unit consists of a 12 foot shale bed at the base followed by a 4 foot band of sandstone and shale with disseminated chert pebbles. A 7 foot band of calcareous siltstone and dense, black limestone marks the top of the unit.
Solomon sandstone 180'			
23	7'	2407'	Sandstone, light grey, medium to coarse-grained; brown weathering.
22	77'	2400'	Sandstone, light-medium grey, platy to massive, fine to medium-grained; numerous ironstone concretion bands; buff and limonitic weathering. Top marked by a 0 to 1 foot bed of black, brittle, sandy shale.
21	40'	2323'	Sandstone, medium grey, fine-grained; bedded and cross bedded; buff and red weathering; rare concretions in bands.
20	5'	2283'	Shale, brownish grey, soft, silty, carbonaceous.
19	45'	2278'	Sandstone, light-medium grey, fine to medium-grained; bedded and cross-bedded; calcareous, glauconitic at base; weathers green, brown, red and buff. Tancredia americana from talus block.
18	6'	2233'	Sandstone and shale interlensing; glauconitic; red weathering.
Upper Concretionary Shale sub-member 447'			
17	41'	2227'	Shale, dark grey, hard, blocky, sandy; red to brown weathering; concretions throughout; mainly covered.

Unit	Thickness of unit	Feet above base	Description
16	70'	2186'	Shale, dark grey, hard, sandy; base interbedded with sandstone; glauconitic; slight iron weathering; concretions are numerous.
15	91'	2116'	Shale, medium-dark grey, hard, blocky, very sandy; sand is disseminated; light grey-brown weathering. Large ironstone concretions are band forming.
14	124'	2025'	Shale, blocky; silty-sandy, silt is disseminated, progressively sandier up section; slightly ferruginous; rare concretions. Lithology assumed constant through covered interval in unit.
13	121'	1901'	Shale, dark grey, blocky to platy, moderately to very silty; silt laminae at base and siltstone bands gradually become prominent, ferruginous. Base of zone placed at first ironstone concretion. Concretions are band forming from 12 feet above base of unit.
Platy Shale member	910'		
12	187'	1780'	Siltstone is major constituent with minor amounts of silty, black shale. Base marked by 2-4 inch band of sandstone containing chert pebbles and by disappearance of oysters. Siltstone bands are rare at top of unit.
11	361'	1593'	As above with siltstone bands lensing to 8 inches. Bands are platy, slightly calcareous and ferruginous; limestone bands and lenses rare. Oysters numerous throughout, wood.
10	25'	1232'	Shale and siltstone interbedded, platy; slight iron weathering. Base marked by first buff weathering limestone band. Uintacrinus sp.?; Inoceramus lundbreckensis; Baculites sp., cf. B. ovatus; oysters.

Unit	Thickness of unit	Feet above base	Description
9	337'	1207'	Shale and siltstone interbedded, hard, blocky to rubbly, ferruginous. Siltstone bands calcareous and are 1/2-2 inches thick. Base placed at last ironstone concretion. Rare oysters. 40 foot covered interval in unit.
Lower Concretionary Shale sub-member 545'			
8	190'	870'	Shale, dark grey, blocky, very silty; silt bands and laminae numerous; badly weathered; concretions are rare and sporadic. Thin bentonite bands in upper half.
7	97'	680'	Shale, dark grey, blocky to rubbly, moderately silty, rare siltstone bands and laminae; badly weathered; sporadic concretions. Talus covered.
6	43'	583'	Shale, medium-dark grey, blocky moderately to very silty; numerous siltstone bands with platy nature; red weathering. Top of unit marked by 3 inch bentonite bed and loss of most siltstone bands and laminae.
5	215'	540'	Shale, dark grey, hard, blocky, moderately silty; rare silt lenses. Concretions and rare bentonite beds throughout. Talus covered. Glauconia sp. at 360 feet.
Lower Concretionary Siltstone sub-member 135'			
4	135'	325'	Shale, dark grey, hard, blocky, very silty; many laminated and cross laminated siltstone bands at base but silt is mainly disseminated in upper half. Large concretions form bands throughout. Scaphites ventricosus.

Unit	Thickness of unit	Feet above base	Description
Striped sub-member		190'	
3	130'	190'	Shale, dark grey, rubbly to blocky, moderately silty; silt laminae and cross laminated bands common. Calcareous content of siltstone bands varies. Unit weathers limonitic to red. Inoceramus exogyroides; Baculites sp., cf. B. codyensis.
2	40'	60'	Shale, dark grey, rubbly to blocky, moderately silty; siltstone bands and sandstone lenses; red weathering. Concretions band forming in top half of unit. Lower 30 feet talus covered.
1	20'	20'	Shale, dark grey, hard, rubbly, moderately silty; rare laminae; ferruginous, red weathering.
	Base		Upper Cardium: Sandstone, light grey, blocky to massive, medium to coarse-grained; slightly calcareous, deep brown and buff weathering. Concretion bands occur throughout this upper unit along with numerous chert pebbles.

Section 2: Cardinal River
S. 13, T. 45, R. 20, W. 5.
Wall and Germundson (1959)

A nearly complete section of Wapiabi was sampled and measured from well exposed outcrops along the river. The formation is about 1840 feet thick, and extends for 1 1/2 miles upstream from the Cardium-Wapiabi contact to the Brazeau formation. All members and sub-members are recognized, and are well-defined.

The entire section has a nearly constant strike, with a dip from 50 to 70 degrees southwest.

The Clioscaphites montanensis-Inoceramus cordiformis zone is the only zone fossiliferous. All fossils were collected from a side-gully on the south side of the river, which exposes an excellent section of the Lower Concretionary Shale sub-member.

To reach the section, a vehicle may be used from Mountain Park as far as Grave Flats forestry cabin (S. 13, T. 45, R. 21, W.5). A good pack-trail follows the Cardinal River from the cabin to the section six miles east. Several camp-sites are present in the river valley.

Unit	Thickness of unit	Feet above base	Description
			Basal Brazeau:
			Sandstone, light grey to light greenish grey, platy, medium to coarse-grained; cross-bedded at base, slightly calcareous; rusty-buff weathering with deep green stain. Unit is 26 feet thick.
			Wapiabi formation
Transition member 140'			
17	55'	1840'	Siltstone to fine-grained sandstone, dark greenish grey, platy to rubbly; interbedded with dark grey to slightl green siltstone containing dark grey shale partings. Certain bands of sandstone lense to 4 feet. Dense, black limestone band near base.

Unit	Thickness of unit	Feet above base	Description
16	85'	1785'	Sandstone, light greenish grey, rubbly, fine-grained; interbedded with siltstone and silty shale. Basal 3 feet are gritty to coarse-grained and grade into finer material at top.
Solomon sandstone 193'			
15	22'	1700'	Sandstone, dark greenish grey, moderately hard on weathered surface, shaly-silty; mainly an interlensing mass of rock. 2' above base is a distinct band of grit containing chert pebbles; chert pebbles up to an inch in length common throughout. Top of unit is a gritty ironstone concretionary band.
14	88'	1678'	Siltstone, dark greenish grey, hard, rubbly to blocky to massive; shale partings, indications of laminae; lensic. At base is first bed of light to dark green, fine-grained sandstone. Sandstone beds interbedded with the siltstone and are up to 10 feet thick.
13	83'	1590'	Sandstone, medium-dark greenish grey, very hard, very fine-grained; lensic, light grey streaks of coarser sand, shale partings; interbedded with medium grey 3-4 inch bands of calcareous siltstone. Base marked by 4 foot zone of extremely hard bands of cross-bedded calcareous sandstone and siltstone and last concretion band.
Upper Concretionary Shale sub-member 279'			
12	82'	1507'	Shale, medium-dark grey, very hard, blocky, very silty-sandy; silt and sand disseminated; red weathering. Base of unit placed at first band of concretions. Concretions are large, the bands increase in number towards top.

Unit	Thickness of unit	Feet above base	Description
11	197'	1425'	Shale, medium-dark grey, very hard, as above. Base marked by appearance of ironstone concretions, sporadic, rare and small at base but increase in number and size towards top of unit. Outcrop spotty through basal 50 feet.
Platy Shale member	588'		
10	228'	1228'	Siltstone and shale interbedded. Siltstone, medium-dark grey, hard, laminated and cross-laminated; calcareous content varies; ferruginous, red weathering. Siltstone bands are up to 3 inches thick; dark grey, silty shale interbeds. Base taken at last lense of dense, dark grey limestone beds.
9	187'	1000'	Shale and siltstone interbedded. Shale, dark grey, hard, very silty; indurated locally; interbedded with 40-60% laminated siltstone bands up to 2 inches thick; red weathering. Base marked by first of a series of dense, dark grey, 6 inch to 1 foot limestone bands and lenses.
8	173'	813'	Shale and siltstone interbedded. Shale, dark grey, hard, very silty; silt disseminated; ferruginous. Siltstone, medium-dark grey, platy; laminated and cross laminated; 1/2-1 inch bands. Base of Platy Shale member marked by disappearance ironstone concretions.
Lower Concretionary Shale sub-member	265'		
7	90'	640'	Shale, dark grey, hard, moderately to very silty; few laminae and bands at base but increase in number towards top; becoming platy, brown-red weathering. Concretions sporadic becoming rare towards top of unit.

Unit	Thickness of unit	Feet above base	Description
6	140'	550'	Shale, dark grey-black, blocky to rubbly, moderately silty; silt mainly disseminated but rare laminae and bands are present. Concretions occur in continuous bands throughout, form mesh-like networks. Inoceramus sp., cf. I. pontoni; Clioscaphites montanensis; C. vermiformis.
5	35'	410'	Shale, dark grey-black, hard, very silty; silt mainly disseminated with rare bands at top. Concretions numerous and small.
Lower Concretionary Siltstone sub-member 160'			
4	160'	375'	Shale, dark grey to dark brownish grey, very hard, silty-sandy, homogeneous; purple-red stain. Concretions large and rare.
Striped sub-member 215'			
3	77'	215'	Shale, as below. Concretions in definite layers. Covered interval of 20 feet in middle of unit.
2	63'	138'	Shale, dark grey-black, moderately to very silty; silt laminae and bands common throughout with concentration of bands at top of unit; red weathering. Base of unit marked by occurrence of first ironstone concretions in the Wapiabi.
1	75'	75'	Shale, dark grey-black, very hard, blocky to rubbly; moderately silty, mainly homogeneous; laminae and bands begin 40 feet above base of unit; slight red weathering.
	Base		Upper Cardium: Sandstone, dark grey, coarse-grained, certain beds shaly, mainly blocky to massive. Concretion bands 8" thick numerous and same composition as the surrounding rock. Concretions stop abruptly at top of Cardium. Chert pebbles common throughout unit which is 12 feet thick.

Section 3: Oldfort Creek
T. 25, R. 8, W. 5.
Wall and Germundson (1959)
Evans (1930)

The section on Oldfort Creek was not measured completely during the summer of 1959. Detailed measurements include the following portions of the section: Lower Concretionary member, lower 210' of the Platy Shale member, and the Upper Concretionary member to the top of a sandstone unit which may be the Highwood sandstone. Sections not measured include the main part of the Platy Shale member, and the Transition member. Because of this, Evans' (1930) thicknesses for the Wapiabi and its members are used. His thickness for the Lower Concretionary zone compares very favourably with the thickness arrived at by the writer.

The Wapiabi formation is fairly complete except for covered intervals in the Platy Shale member. The section is 1575 feet thick, and extends for about 5 miles upstream from the Cardium-Wapiabi contact, at the junction of Oldfort Creek and Bow River, to the Belly River formation. All members are recognized but only the sub-members in the Upper Concretionary zone are defined.

Beds dip gently throughout, while the strike varies considerably especially in the Platy Shale member.

Zonal indices of the Inoceramus deformis-Scaphites preventricosus and I. involutus-S. ventricosus zones were collected in the Lower Concretionary member.

The section crosses highway number 1A and any part may be reached easily.

Unit	Thickness of unit	Feet above base	Description
			Basal Belly River
			Wapiabi formation
Transition member	125':	Evans (1930), gave a total thickness of 1775 feet for the Wapiabi. He included all the beds above the Platy Shale member in the Upper Concretionary member and gave a thickness of 510 feet. During the summer the writer assigned a thickness of 385 feet for the Upper Concretionary member and the sandstone unit above. The thickness for the Transition member, following Evans' total thickness for the Wapiabi Shale, is set at 125 feet.	
		1775'	Sandstone bands interbedded with dark, silty shale.

Unit	Thickness of unit	Feet above base	Description
Highwood sandstone? 60'			
16	60'	1650'	Sandstone, medium grey, fine to medium-grained, blocky to massive, ferruginous.
Upper Concretionary Siltstone sub-member 170'			
15	28'	1590'	Shale, medium grey, hard, very silty-sandy; interbedded with bands of fine-grained sandstone, glauconitic at base.
14	78'	1562'	Shale, medium-dark grey, hard, blocky, silty-sandy; interbedded with calcareous sandstone bands. Concretions are common and form bands. Oysters.
13	64'	1484'	Shale, dark grey, sandy; interbedded with dark grey, calcareous sandstone bands; slight iron weathering. Concretions throughout. Base placed at first sandstone band.
Upper Concretionary Shale sub-member 155'			
12	110'	1420'	Shale, medium-dark grey, very hard, blocky; silty-sandy; coarse material is disseminated; occasional calcareous sandstone band or lense; slight iron weathering. Concretions band forming. 20 foot covered interval near top. Pholadomya sp., P. occidentalis.
11	45'	1310'	Shale, medium-dark grey, hard, blocky, very silty at base and becomes sandy above; rare small bands and laminae at base but becomes homogeneous towards top of unit; slight iron weathering; concretions mark base and become numerous and sporadic 15 feet above base.

Unit	Thickness of unit	Feet above base	Description
Platy Shale member	745'		
			Since the Platy Shale member was not measured or described in detail by the writer during the 1959 field season, the descriptions and measuremens by Evans (1930) are used. (Siltstone bands and laminae become rare throughout the last 60 feet of the Zone. Various covered intervals throughout).
10	255'	1265'	Dark shale and sandy shale with bands 1/2 to 4 inches thick of calcareous, shaly, fine-grained, cross-bedded sandstone.
9	360'	1010'	Sandy shale with bands 1/2 foot to 6 feet thick of calcareous, shaly, cross-bedded sandstone. Anomia sp. and a small oyster from 765-880 feet (above base of Wapiabi).
8	40'	650'	Black shale, a few sandy layers.
7	50'	610'	Sandy shale with many crossbedded, shaly, fine-grained, sandstone beds. Scaphites ventricosus and Baculites cf. anceps at 1170 feet (below top of Wapiabi).
6	40'	560'	Black shale. Scaphites ventricosus.
			The lower 210 feet of the Platy Shale zone contains ironstone concretions.
Lower Concretionary member	520'		
5	150'	520'	Shale, medium-dark grey, blocky, very silty to sandy; numerous laminated and cross-laminated siltstone bands, rare calcareous sandstone bands. Concretions band forming and sporadic. Rare bentonite beds. Iron weathering. Inoceramus sp., cf. I. umbonatus; Scaphites ventricosus.

Unit	Thickness of unit	Feet above base	Description
4	120'	370'	Shale, dark grey, hard, blocky, very silty; siltstone bands numerous; concretions band forming at base and sporadic near top; red weathering. Inoceramus sp., cf. I. umbonatus.
3	60'	250'	Shale, dark grey, very hard, blocky, silty at base, sandy at top; numerous siltstone bands and rare calcareous sandstone lenses. Rare sporadic concretions throughout. Chert pebbles near base.
2	100'	190'	Shale, dark grey-black, rubbly to blocky, moderately silty; rare siltstone bands and laminae; silt mainly disseminated. Red weathering concretions throughout. 30 foot covered interval includes lower contact. Inoceramus sp., cf. I. deformis; I. sp., cf. I. pontoni.
1	90'	90'	Shale, dark grey, rubbly at base to blocky at top; slightly-moderately silty; silt disseminated; red weathering. Contact with unit above covered; thickness estimated. Chert pebbles occur throughout basal 8'. Inoceramus undabundus; Scaphites preventricosus.
Base			Upper Cardium:
			Sandstone, light to medium grey, fine to medium-grained, massive to platy. Ferruginous, red and buff weathering. Unit is 35 feet thick and contains 1' shaly sandstone beds.

Section 4: Mill Creek
Location: S. 12, T. 5, R. 2, W. 5.
Wall and Germundson (1959)

The Wapiabi formation is nearly complete from the Cardium to the lower beds of the Platy Shale member, and covered intervals are present above to the base of the Belly River. The formation is about 1643 feet, and is exposed along 1 mile of the valley. All members and sub-members are recognized except the Upper Concretionary member, where the typical character of the rock is lost.

Thicknesses are difficult to estimate in the Platy Shale member because of folding and faulting.

The Inoceramus deformis-Scaphites preventricosus, I. involutus-S. ventricosus and Clioscaphites montanensis-I. cordiformis zones are fossiliferous.

A vehicle may be used to drive up to the middle of the section. Trails follow the creek, and the section can be visited rapidly.

Unit	Thickness of unit	Feet above base	Description
			Basal Belly River:
			Sandstone, light grey, hard, massive, coarse-grained; calcareous, micaceous, ferruginous; weathers buff and red. Unit is approximately 30 feet thick.
			Wapiabi formation
Transition member 129'			
16	95'	1643'	Shale, dark grey, hard, very silty; interbedded with sandstone (light to medium grey, calcareous). 85% sandstone, 15% shale.
15	34'	1548'	Shale, dark grey, hard, blocky to platy, very silty. Base of unit is marked by introduction of 3-4 inch bands of dark grey, calcareous siltstone. Bands thicken to top of unit and become fine to medium-grained sandstone bands.
Upper Concretionary member? 287'+			
14	25'	1514'	Shale, dark brown grey, hard, platy-blocky, very silty; cross-laminated siltstone bands throughout.

Unit	Thickness of unit	Feet above base	Description
13	108'	1489'	Shale, dark grey to dark brownish grey, hard, platy, moderately silty with rare calcareous siltstone lenses, sandstone bands and laminae. Shale is very calcareous but becomes less so towards top of unit. Bentonite bands throughout; very rare limestone concretions in basal area.
12	154'	1381'	Shale as above. Top of unit marked by 1 foot band of dense, dark grey limestone containing numerous fossils. Inoceramus sp., cf. I. lundbreckensis; Pteria sp. Anomia subquadrata.
		1227'	Covered interval estimated to consist of 100 feet of section. Contact between members not exposed.
Platy Shale member 522'+			
11	248'	1127'	Siltstone, medium grey, hard; laminated and cross-laminated in bands and lenses; slightly ferruginous locally. The bands concentrate in groups and are interbedded with very silty, dark grey shale.
10	147'	879'	Siltstone, medium grey, occurring in bands, lenses and laminae, (interbedded with minor amounts of shale, dark grey-dark brownish grey, platy, moderately-very silty; laminae present; little iron showing). Base of unit and zone taken at last ironstone concretion and influx of siltstone bands.
9	127'	732'	Shale, brownish grey, very hard, blocky, silty-sandy; siltstone bands numerous at base but less concentrated above, calcareous; little iron weathering. Ironstone concretions rare except locally. Clioscaphites montanensis.

Unit	Thickness of unit	Feet above base	Description
Lower Concretionary Shale sub-member 262'			
8	85'	605'	Shale, dark brownish grey, very hard, blocky, very silty; siltstone bands numerous at base and occur in varying numbers throughout; laminae numerous; slight iron weathering; various concretions throughout. Top of unit marked by continuous ironstone band, medium grey, calcareous, glauconitic?. Baculites ovatus.
7	40'	520'	Shale, dark brownish grey, blocky to rubbly, very silty, containing many laminae and laminated siltstone bands. Concretions significantly missing.
6	52'	480'	Shale, dark grey, very hard, blocky, very silty; siltstone bands rare at base but increasing in number up section (are up to two inches thick). Ironstone concretions missing in lower 20 feet and are rare above.
5	30'	428'	Shale, medium to dark grey, blocky, very silty-sandy; rare siltstone bands. Top of unit marked by 4 foot band of shale, limestone bands containing chert pebbles, and limestone concretions.
4	55'	398'	Shale, dark grey, rubbly-blocky, moderately to very silty; platy siltstone bands and laminae are numerous. Amount of calcareous material in the bands varies. Bands are laminated and cross-laminated, ferruginous. Crystalline, red to brown limestone concretions at top of unit.

Unit	Thickness of unit	Feet above base	Description
Upper Concretionary Siltstone sub-member 160'			
3	160'	343'	Shale, medium-dark grey, very hard, blocky, sandy (shaly sandstone at base); mainly disseminated silt with areas of greater induration; slight iron weathering. Many ironstone concretions throughout becoming rare towards top. Upper 40 feet covered. Scaphites ventricosus.
Striped sub-member 183'			
2	114'	183'	Shale, dark grey-black, very hard, blocky to platy to rubbly, moderately to very silty; laminae, small indurated lenses and silt bands rare but persistant; deep red and purple iron stain. Base marked by first ironstone concretions, cream weathering, limestone concretions showing cone-in-cone structure, and a sequence of blue-grey bentonite beds. Inoceramus deformis.
1	69'	69'	Sandstone (and siltstone), dark grey, hard, blocky to platy, fine-grained; interlensing with black, very silty shale; few silt bands. Gradational lithologic change up section to black shale. Material is ferruginous and is red weathering.
	Base	Upper Cardium:	Sandstone, dark grey, hard, fine-grained; shale partings; ferruginous. Ironstone concretion bands numerous but stop abruptly at contact. Gradational lithologic change into Wapiabi. (No chert pebbles noted in region of contact).